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ANNUAL REPORT

J C Branner

UPON THE

U. S,

GEOGRAPHICAL SURVEYS OF THE TERRITORY OF THE UNITED STATES WEST OF THE 100TH MERIDIAN, IN THE STATES AND TERRITORIES OF CALIFORNIA, COLORADO, KANSAS, NEBRASKA, NEVADA, OREGON, TEXAS, ARIZONA, IDAHO, MONTANA, NEW MEXICO, UTAH, WASHINGTON, AND WYOMING.

BY

GEORGE M. WHEELER,

CAPTAIN CORPS OF ENGINEERS, U. S. ARMY;

BEING

APPENDIX OO

OF THE

ANNUAL REPORT OF THE CHIEF OF ENGINEERS FOR 1879.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1879.

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NOTE.

There accompany the extra copies of Appendix O O of the Report of the Chief of Engineers, being annual report of Capt. George M. Wheeler, Corps of Engineers, in charge of United States geographical surveys, seven topographical atlas sheets, *i. e.*, Nos. 32 D, 47 B, + 47 D, 61 D, 73 A, 78 A, and 84 B, with the classification of the lands shown in color, as arable or agricultural with irrigation, arid or barren, timber and grazing, and the location of mineral deposits, that are in continuation of the series in course of preparation as the results of these surveys. (See progress map herewith and note attached to the cases for descriptive list of maps.)

[EXTRACT FROM THE ANNUAL REPORT OF THE CHIEF OF ENGINEERS TO THE SECRETARY OF WAR.]

OFFICE OF THE CHIEF OF ENGINEERS,
Washington, D. C., October 20, 1879.

* * * * * * *

GEOGRAPHICAL SURVEYS OF THE TERRITORY OF THE UNITED STATES WEST OF THE ONE-HUNDREDTH MERIDIAN.

Officer in charge, Capt. George M. Wheeler, Corps of Engineers, having under his orders First Lieut. Samuel E. Tillman and Second Lieuts. Eugene Griffin and Willard Young, Corps of Engineers; First Lieut. B. H. Randolph, Third Artillery, and Second Lieut. M. M. Macomb, Fourth Artillery.

During the year the following gentlemen have been engaged in the investigation of special subjects: Prof. John J. Stevenson, geologist, assisted by I. C. Russell; H. W. Henshaw, ornithologist; Dr. J. T. Rothrock, with the assistance of the colaborers in the botanical branch, brought to a close the proof reading of his report and those of others, contributing to volume VI, which volume is now in print.

Prof. F. W. Putnam, curator of the Peabody Museum, assisted by Dr. C. C. Abbott, of Trenton, N. J., and Lucien Carr, completed his portion of the manuscript of volume VII, and this report is now passing through the several stages of proof.

Prof. J. J. Stevenson has paid especial attention to the outcrops of the Coal Measures at the east base of the Rocky Mountains, more particularly from Trinidad, Colo., to the southward as far as Santa Fé, and has determined the geological formations covering an area of fully 7,000 square miles.

The parties of the season of 1878 were, from lateness of appropriations, unable to take the field until the first week in July, thus losing the early portion of the season, at which time, however, the Colorado, Utah, and California sections were organized at Fort Garland, Colo.; Fort Union, N. Mex.; Ogden, Utah; Carson, Nev., and Fort Bidwell, Cal.

The several main parties, nine in number, were distributed in Colorada, New Mexico, Texas, Arizona, Utah, Nevada, California, Oregon, and Washington Territory, and during the season carried on their labors in portions of atlas sheets 20 A, 20 C, 29 A, 29 C, 38 B, 56 B, 56 D, 61 D, 70 A, 70 C, 73, 76, 77 D, 78 A, 83, 84, 90 A, and 90 B. (See progress map accompanying Appendix O O.)

The drainage basins entered were: Portions of the northwestern arm of the "great interior basin"; of the Upper Klamath and of the Columbia basins; the mountain basins at the headwaters of the Tuolumne, Stanislaus, Merced, and Feather rivers, all of which are tributary to the basin of the Sacramento; also portions of the basin of the Rio Grande.

The special survey of Great Salt Lake and vicinity, including its meander, that of the islands and their contours, together with a number of soundings, has been completed, and observations upon surface evaporation have been continued as far as practicable.

At the Washington office the reductions needed for map construction and the subsequent delineation are carried on continuously.

A temporary field-office at Ogden, Utah, has been kept up throughout the season of 1878. Five bases were measured at or near the following points: (1) Austin, Nev.; (2) The Dalles, Oregon; (3) Fresno, Cal.; (4) Fort Bliss, Tex.; (5) Fort Bayard, N. Mex.

The number of sextant latitude stations occupied was 90; 64 triangles about bases were measured, and observations made at 70 main and 87 secondary triangulation stations; 763 three-point and cross-sight stations and 15,936 minor points were occupied.

Magnetic variations were determined at 197 stations, and 10,299 miles measured; cistern and aneroid barometer observations for altitude differences were taken at 8,098 stations. The location of 23 mineral and thermal springs has been noted and 15 mining-camps visited.

Collections of specimens of minerals, fossils, mammals, birds, reptiles, fishes, insects, shells, &c., have been made.

In the office 43 astronomical positions have been computed, 90 stations adjusted, 904 triangles, 1,808 distances, 292 longitudes and latitudes, and 255 azimuths computed. Altitudes have been computed of 1,041 cistern and 6,983 aneroid barometer stations.

There have been 14 sheets and parts of sheets plotted on a scale of 1 inch to 2 miles, and 8 special sheets drawn to various scales.

Seven completed atlas sheets in hachures with land-classification colors added will be ready to be submitted in time to accompany extra copies of Captain Wheeler's annual report, viz, 32 D, 47 B, +47 D, 61 A, 73 A, 78 A, 84 B; 2,633 reports and 14,906 maps have been distributed during the year.

The call for maps is increasing. There have been published since the commencement of this survey of the regular atlas sheets, not enumerating special maps, as follows:

Topographical sheets	28
Advancing toward publication and to accompany extra copies of appendix	5
Land classification sheets	21
Geological sheets	7

There yet remain to be published from data already gathered the following number:

Topographical sheets	23
Land classification sheets	12
Geological sheets	4

During the month of April, 1879, the Utah section resumed its field labors, and subsequently two parties of the Colorado section and one party of two divisions of the California section were organized.

As no funds were available for the prosecution of field-work after June 30 current, it became necessary to withdraw these parties at that date, which was done, and office work resumed.

During the year volume VI of the quarto reports authorized by act of Congress has appeared. Volume VII is now being proofed.

The special reports now remaining unpublished are volume 1, Geographical Report, and tables of geographical positions, altitudes, distances, &c.

The special map of the Lake Tahoe region, on a scale of 1 inch to 1 mile, awaits publication.

The thirteen remaining land-classification maps, of which 20 already are published, are being prepared with all possible rapidity, as are all those including topographical and geological, 40 in number, for which data have been gathered.

The main results of the survey are the topographical maps, that requiring slow and skillful delineation, demand much time for their completion.

Captain Wheeler's report, with estimates and appendixes, is appended. (See Appendix O O.)

* * * * * * *

APPENDIX O O.

ANNUAL REPORT OF CAPTAIN GEORGE M. WHEELER, CORPS OF ENGINEERS, U. S. A., FOR THE FISCAL YEAR ENDING JUNE 30, 1879.

GEOGRAPHICAL SURVEYS OF THE TERRITORY OF THE UNITED STATES WEST OF THE ONE HUNDREDTH MERIDIAN, IN THE STATES AND TERRITORIES OF CALIFORNIA, COLORADO, KANSAS, NEBRASKA, NEVADA, OREGON, TEXAS, ARIZONA, IDAHO, MONTANA, NEW MEXICO, UTAH, WASHINGTON, AND WYOMING.

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REPORT.

UNITED STATES ENGINEER OFFICE,
GEOGRAPHICAL SURVEYS WEST OF THE 100TH MERIDIAN,
Washington, D. C., June 30, 1879.

GENERAL: I have the honor to submit the usual report for the fiscal year ending June 30, 1879.

Appropriations for office work alone having been granted at the past session of Congress, all parties were withdrawn and field work suspended at the close of the fiscal year.

SUMMARY OF FIELD AND OFFICE OPERATIONS.

Early in July, 1878, nine parties, two operating in double lines, of the expedition of that year took the field as follows: One at Fort Stanton, N. Mex.; two at Fort Garland, Colo.; three at Ogden, Utah; two at Carson, Nev., and Fort Bidwell, Cal.

The separately organized astronomical parties commenced their labors, one at the observatory of the survey at Ogden, Utah, a second at Fort Bliss, Tex., and a third at The Dalles, Oreg.

The political divisions entered by the above parties, connecting areas with those occupied heretofore, were California, New Mexico, Texas, Arizona, Utah, Nevada, Colorado, Oregon, Washington Territory, and in portions embraced by atlas sheets 20 A, 20 C, 29 A, 29 C, 38 B, 56 B, 56 D, 61 D, 70 A, 70 C, 73, 76, 77 D, 78 A, 83, 84, 90 A, and 90 B. (See progress map herewith.)

The disbandment of the expedition was successfully accomplished at Sacramento, Cal.; Fort Bidwell, Cal.; Ogden, Utah; Fort Garland, Colo.; Fort Stanton, and Fort Bayard, N. Mex.

The parties were in the field for a period exceeding five months without casualties, and the accumulation of data by the observers, 46 in number, exceeded that of any former year. Valuable observations, other than those required for the resulting topographical map, were gathered by specialists in geology, zoology, upon mining at the Comstock Lode, Nevada, and elsewhere.

During April, 1879, a special party of the Utah section was engaged in the topographic and hydrographic survey of the Great Salt Lake and vicinity, while two parties of the Colorado section at Fort Garland, Colo., and one, working in two divisions, of the California section at Sacramento, Cal., were organized early in May to prosecute their labors in parts of the political divisions of Colorado, New Mexico, Utah, and California, embraced by atlas sheets 41 A, 41 C, 41 D, 52 D, 56 D, 69 D, 70 A, 70 C, 77 B, 78 A. (See progress map herewith.) The parties were withdrawn from the field to resume office labors June 30, 1879.

Among these parties, and from the chief of which no special report was received, was one engaged in triangulation observations in Central Colorado, under Louis Nell, assistant. This party was successful in its operations, locating along its route a number of new mining camps, as

Silver Cliff, Leadville, Ten Mile, Carbonate, Frying Pan Gulch, Monarch and the new discoveries in the basin of the Gunnison.

The group of mines with Leadville as a center was found to be of undoubted present richness and of great future promise.

Astronomical stations for telegraphic longitudes and zenith telescop latitudes were occupied: 1. Ogden, Utah (connecting station); 2. Wall Walla, Wash.; 3. Dalles, Oreg.; 4. Fresno, Cal.; 5. Fort Bliss, Tex.; (Fort Bayard, N. Mex.

As usual, at the Washington office a number of draughtsmen and computers were steadily employed in reducing observations, plotting result and in the delineation of the final atlas sheets. The field reducin office at Ogden was discontinued during the season, to be resumed a its close and continued throughout the year.

The following changes have occurred with regard to the detail of officer serving upon the work:

Lieut. Charles C. Morrison, then Sixth United States Cavalry, repaire to West Point to report to the Superintendent of the Military Academy August 28, 1878, pursuant to paragraph 2, Special Orders No. 7 Headquarter's of the Army, Adjutant-General's Office, April 13, 1878.

First Lieut. Rogers Birnie, jr., Ordnance Department, was relieved fro duty March 12, 1879, by virtue of paragraph 2 of Special Orders No. 5 Headquarters of the Army, Adjutant-General Office, 1879, and to repo in person to the Chief of Ordnance.

First Lieut. Thomas W. Symons, Corps of Engineers, was relieved fro duty by paragraph 5 of Special Orders No. 58, Headquarters of the Army Adjutant-General's Office, March 11, 1879, and ordered to report to th commanding general Department of Columbia for duty, and was relieved from the survey June 1, 1879.

Second Lieut. H. H. Ludlow, Third Artillery, was relieved by paragraph 7, Special Orders No. 122, Headquarters of the Army, Adjutan General's Office, May 23, 1879, from duty, and ordered to join his battery which took effect June 1, 1879.

Dr. J. T. Rothrock, University of Pennsylvania, completed the proo reading of his report and those of the several other botanical author contributing to Vol. VI, that has now been issued from the Governmen Printing Office.

Prof. F. W. Putnam, curator of the Peabody Museum, Cambridge, Mass assisted by Dr. C. C. Abbott and Lucien Carr; completed his portions (the manuscript of Vol. VII, which is now passing the different stage of proof at the Government Printing Office.

Sergt. Thomas Knight, Company F; Corpl. Joseph T. Hill, Compan I; Artificer Joseph Messer, Company E, and Private Brenholz, Compan D, all of the Fourteenth Infantry, were detailed, by selection, pursuan to paragraph 1, Special Order No. 29, Headquarters of the Army, Adjutant-General's Office, February 8, 1878, and have performed excellen service.

To the officers and other assistants engaged in prosecuting the arduous labors of the survey for another field-season, being that of the nint regular expedition under my command, independent of the winter campaign of 1875-'76 and the season of 1879, just closed, I desire to exten my recognition of the unflagging energy and willingness shown an steady improvement in and rapidity of execution of the several parts (the work.

As usual the supply branches of the War Department have aide(thereby admitting of the retention of a larger number of profession assistants than could have been secured by means of the direct appropriation alone.

Prominent features from the results of observations in the field and reductions in the office are herewith.

FIELD SEASON OF 1878.

Number of main stations occupied for astronomical observations		5
Sextant latitude stations		90
Bases measured		5
Triangles about bases measured		64
Main trangulation stations occupied		70
Secondary triangulation stations occupied		87
Three-point stations occupied		763
Stations on meander		15,936
Miles measured		10,299
Cistern-barometer stations occupied		1,041
Aneroid stations occupied		7,057
Magnetic variations observed		197
Monuments built		156
Mining camps visited		15
Mineral and thermal springs noted		23
Minerals, fossils, and ores; specimens collected, approximately		1,467
Mammals, specimens collected		11
Birds, specimens collected		243
Birds' eggs collected		12
Mammals (alcoholic) collected		3
Mammal crania collected		1
Bird crania collected		7
Fishes	specimens	200
	lots	12
Snakes	specimens	25
	lots	16
Lizards	specimens	25
	lots	7
Batrachians	specimens	50
	lots	11
Hemiptera collected		1
Orthoptera	specimens	200
	lots	6
Shells	specimens	25
	lots	3
Crustaceans	specimens	12
	lots	1
Fossil leaves specimens		72

OFFICE—WINTER 1878-'79.

Astronomical positions computed	42
Triangulation stations computed	90
Geodetic figures computed	76
Distances computed	1,808
Azimuths computed	255
Longitudes and latitudes computed	292
Cistern-barometer altitudes computed	1,041
Aneroid-barometer altitudes computed	6,983
Sheets and parts of sheets plotted (1 inch to 2 miles)	14
Special sheets drawn (various scales)	8
Atlas maps (1 inch to 4 miles) published	6
Atlas maps (1 inch to 4 miles) approaching completion for publication	4
Reports distributed	2,633
Maps distributed	14,906
Sextant latitude stations computed	60
Number of main triangulation stations computed	59
Number of triangles computed	904
Number of secondary triangulation stations computed	37
Number of points fixed by cross-sights computed	64
Number of three-point stations computed	132

Reports in course of publication: Volumes I, VII, and tables of geographical positions, altitudes, distances, &c.

Maps in course of preparation for publication:

Topographical atlas sheets	**23**
Land-classification atlas sheets	**12**
Geological atlas sheets	**4**
Total	**39**

Certain of the above sheets must await publication until additional triangulation and topographical observations are made; that could, however, be accomplished in one season by a number of small parties, specially equipped for this class of work, and for which funds equal in amount to the present office estimate ($30,000) could be most advantageously expended.

Lieutenant Tillman, chief of party 1, Utah section, also sextant and triangulation observer, was during the winter in charge of the geodetic and barometric reductions, and in preparation of his report, that is submitted herewith as Appendix A.

Lieutenant Symons, as chief of party 1, was engaged in the field as sextant and triangulation observer. He was assigned to the charge of the Ogden office, that had been organized by Lieutenant Tillman at the close of the field season. He was thence ordered to Washington, where, completing his sextant reductions, and while supervising the final plotting of several triangulation sheets, he was relieved June 1. His executive report appears herewith as Appendix B.

The report of Lieutenant Griffin, chief of party 2, Colorado section, appears as Appendix C. This officer made both sextant and triangulation observations in the field, and, during the office period was in charge of the topographical room, and engaged also in computations and in preparation of report.

Lieutenant Young succeeded Lieutenant Symons in charge of the Ogden office. As chief of party 2, Utah section, he was engaged in sextant work in the field and in computations in the office. His report appears as Appendix D. While chief of party on Salt Lake survey, his other duties were that of triangulation observer.

The office duties of Lieutenant Birnie, until date of being relieved, March 1, were in supervision of reductions of work of his parties, both for 1877 and 1878, in preparation of his report (see Appendix E), and incidentally in computations.

Lieutenant Macomb carried on sextant and triangulation observations in the field. His office duties consisted in supervising final map drawings, in preparation of report (see Appendix F), and in topographical reductions.

Party 2, Utah section, with Lieutenant Ludlow as chief, assisted by Francis Klett, was engaged in special base measuring and triangulation observations near Austin, Nev., and at and eastward from Fresno, Cal.

I desire to state the high appreciation in which the services of Messrs. Nell, Thompson, Maxson, Spiller, Carpenter, Karl, and Polhemus, field topographical assistants, are held.

ASTRONOMICAL.

Five main astronomical stations were occupied during the 1878 season, at or near the following localities: 1. Fort Bliss, Tex.; 2. Fort Bayard, N. Mex. (Miles Rock, observer); 3. Dalles, Oreg.; 4. Walla Walla, Wash.; 5. Fresno, Cal. (John H. Clark, observer).

The plan and methods of observations and subsequent computation are the same as have been in use upon the survey almost continuously since its commencement, and are shown in Vol. II. Observations for personal error were made by the automatic personal equation apparatus devised by Dr. F. Kampf, late assistant of the survey, and perfected at this office.

One of the peculiarities of this astronomical campaign consisted in the opportunity which was afforded of sending signals from Fort Bayard, N. Mex., to Ogden, Utah, via Santa Fé, N. Mex., Denver, Colo., and Cheyenne, Wyo., also via Tucson, Ariz., Fort Yuma, and Sacramento, Cal., thus using two extended circuits, that together make up the sides of a large quadrilateral. Thanks are due to Norvin Green, president Western Union Telegraph Company, and General A. J. Myer, Chief Signal Officer, U. S. A., the former for the free use of the wires of his company, and the latter for his courtesy in extending, while the party was in the field, the immediate use of the government line from Santa Fé southward. The report in the required usual form of the results of the computations by Professor Safford follows herewith.

REPORT OF PROF. T. H. SAFFORD. COMPUTATIONS OF THE LATITUDE AND LONGITUDE OF FIVE ASTRONOMICAL STATIONS.

SIR: I have the honor to present my report on the computations of the latitudes and longitudes of five stations, namely:

1. Walla Walla, Wash.
2. The Dalles, Oreg.
3. Fresno, Cal.
4. Fort Bliss, Tex.
5. Fort Bayard, N. Mex.

The observations at stations 1, 2, 3 were made by Assistant John H. Clark; those at stations 4, 5 by Assistant Miles Rock; the corresponding time observations at Ogden, Utah, by myself.

The observations made at Ogden include transits taken on every available night during the season, in order to make sure of the rate and error of my chronometers. Nine nights only were so cloudy that no observations were taken, between the dates July 27 and October 10.

These observations were all so far reduced as to give approximate clock and instrumental corrections; and in addition the following right ascensions for 1878.0 of stars not otherwise well determined:

Star's name.	A. R. 1878.0.	No. of obs.	Declination. 1878.0
	h. m. s.		° ′
166 Heis Herculis	17 45 39.105	12	+ 29 21.4
204 Heis Herculis	18 12 46.084	11	18 5.1
8 Heis Lyræ	18 21 16.398	6	29 45.6
11 Heis Lyræ	18 32 8.760	8	33 22.
28 Heis Cygni	18 38 2.868	9	32 8.5
Piazzi XX, 358	20 46 17.473	6	27 47.6
Piazzi XXII, 158	22 29 56.600	4	+ 19 38.8

In a few cases these right ascensions were not used in the reductions, which were completed before they were obtained.

The following is the table of approximate chronometer-corrections, together with the final corrections obtained by the method of least squares for the nights upon which signals were exchanged.

All the observations of this campaign were by the eye and ear method.

Date.	Hour.	Preliminary corrections.	Hour.	Final corrections.*	Hourly rate.
	h. m.	m. s.	h.	m. s.	s.
July 25	17 45	— 0 3.16			
26	18 30	8.04			
27	15 52	12.05			
	18 25	12.59			
28	16 10	16.81			
	17 50	17.11			
29	15 50	20.87			
	17 50	21.33			
30	16 25	25.09			
31	16 15	29.46			
Aug. 1	16 20	33.53			
2	16 10	37.42			
3	18 15	41.68			
4	16 40	45.49			
5	16 30	49.27			
	18 50	49.72			
6	17 10	53.33			
7	18 0	— 0 56.92			
8	18 0	— 1 0.99			
9	17 0	4.61			
10	17 30	8.26			
11	17 30	11.94			
12	17 30	15.75	18.3	— 1 15.818	— 0.152
	19 10	15.87			
13	17 30	19.14			
14	17 30	22.86			
17	17 30	34.70			
18	18 30	39.19			
19	17 30	42.77	19.25	— 1 43.126	— 0.171
	21 0	43.44			
20	18 0	47.34			
21	18 30	51.04	19.25	— 1 51.106	— 0.162
	20 0	51.16			
23	18 0	— 1 59.14			
24	18 0	— 2 3.02			
25	18 0	7.27			
26	18 0	11.60	19.5	— 2 11.905	— 0.175
	21 0	12.19			
27	18 0	15.75			
28	18 0	19.80	19.5	— 2 20.041	— 0.166
	21 0	20.27			
29	17 30	23.62			
30	18 30	27.49			
	20 0	27.57			
31	18 30	31.58			
Sept. 1	19 0	35.37			
5	19 0	50.83	20.0	— 2 51.014	— 0.153
	21 0	51.23			
6	19 0	54.42			
7	19 0	58.18	21.0	— 2 58.570	— 0.152
	23 0	— 2 58.98			
8	19 0	— 3 1.90	20.75	— 3 2.165	— 0.134
	22 30	2.43			
9	18 48	4.87			
10	19 0	2.28	20.75	— 3 2.270	†+ 0.007
	22 30	— 3 2.24			
11	19 0	— 2 59.80	20.75	— 2 59.658	+ 0.108
	22 30	59.55			
12	19 0	57.58	20.75	— 2 57.440	+ 0.081
	22 30	57.33			
13	19 0	56.01	20.5	— 2 55.990	+ 0.067
	22 0	55.99			
14	19 0	54.55			
15	19 0	53.28			
16	19 0	51.73			
17	21 0	50.56	21.0	— 2 50.591	+ 0.048
19	19 0	48.02			
20	19 0	46.07	20.5	— 2 45.984	+ 0.082
	22 0	45.90			
21	19 0	44.16	20.5	— 2 44.100	+ 0.077
	22 0	— 2 44.04			

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*In this, the least square reduction, the formula for weight used was $w = \frac{1.3}{1 + 0.3, \sec.^2 \delta}$ See vol. II pp. 343 to 347 of the quarto reports of this survey.

†Mr. Wallace dropped the chronometer, hence this change of rate.

Date.	Hour.	Preliminary corrections.	Hour.	Final corrections.	Hourly rate.
	h. m.	m. s.	h.	m. s.	s.
Sept. 22	19 0	— 2 42.54	20.7	— 2 42.424	+ 0.076
	22 24	42.31			
23	22 0	40.37			
24	20 0	38.79			
25	19 0	36.78			
26	19 30	34.98	21.15	— 2 34.814	+ 0.060
	22 48	34.65			
27	20 0	33.65	21.5	— 2 33.603	+ 0.062
	23 0	33.54			
28	19 30	31 99			
30	20 0	28.42	22.0	— 2 28.249	+ 0.071
	0 0	28.00			
Oct. 1	20 0	26.65	21.85	— 2 26.502	+ 0.072
	23 12	26.35			
2	20 30	24.74			
3	20 0	22.46	21.75	— 2 22.374	+ 0.092
	23 30	22.27			
4	19 30	20.52			
5	20 0	18.56	21.50	— 2 18.440	+ 0.076
	23 0	18.31			
6	20 30	16.77	21.75	— 2 16.720	+ 0.066
	23 0	16.66			
7	20 30	15.32	21.75	— 2 15.278	+ 0.062
	23 0	15.23			
8	20 48	13.84	22.0	— 2 13.763	+ 0.063
	23 12	13.66			
10	20 36	10.84	21.9	— 2 10.762	+ 0.063
	23 12	— 2 10 67			

In the calculation of these chronometer corrections, the star-catalogues used were **the German** ephemerides of 539 stars, the American Ephemeris, and the Survey Catalogue of 2,018 stars. The chronometer corrections need to be increased by about $0^s.01$ to correspond to the revised German ephemerides, published in 1878 or 1879, after my return from the field; this revision was employed in the reduction of Mr. Clark's and Mr. Rock's observations.

Observations for personal equations with Mr. Clark were made at Ogden, which here follow; the bracketed chronometer corrections ($dt+m$) are those given by the polar stars. The difference is almost exactly zero, and has been neglected, as Mr. Clark observed with a different instrument from his own.

Observations for personal equation.—J. H. Clark and T. H. Safford.

October 19, 1878. First group. Clamp East.

Star's name.	T.			n tan δ.	c sec δ.	T'.	A. R.	dt + m + 2ᵐ.	
								C.	S.
	h.	m.	s.	s.	s.	s.	s.	s.	s.
γ Cygni	20	19	42.83	—0.28	+0.26	42.81	53.21	+10.40	
41 Cygni		26	16.79	—0.21	+0.24	16.82	27.28		+10.46
ε Delphini		29	15.78	—0.07	+0.20	15.91	26.18	10.27	
β Delphini		33	42.20	—0.09	+0.21	42.32	52.75		10.43
δ Delphini		39	38.48	—0.09	+0.21	38.60	48.89	10.29	
ε Cygni		43	8.66	—0.23	+0.24	8.67	19.17		10.50
Piazzi XX 358		48	9.98	+0.18	+0.23	10.03	30.32	10.29	
32 Vulpeculae		51	14.20	—0.18	+0.23	14.25	24.52		10.27
Br. 2749	20	54	52.18	—1.95	+1.16	51.39	1.78	[10.39]	
61 Cygni	21	3	18.24	—0.27	+0.25	18.22	28.65		10.43
ζ Cygni	21	9	37.10	—0.19	+0.23	37.14	47.59	10.45	

Observations for personal equations.—J. H. Clark and T. H. Safford.

October 19, 1878. Second group. Clamp east.

Star's name.	T.			$n \tan \delta$.	$c \sec \delta$.	T′.	A. R.	$dt + m + 2^m$.	
								C.	S.
	h.	m.	s.	s.	s.	s.	s.	s.	s.
20 Cephei	22	3	10.51	−0.36	+0.43	10.58	20.68		10.10
π^2 Pegasi		6	27.06	−0.12	+0.24	27.18	37.57	10.39	
Piazzi XXII. 32		9	56.29	−0.10	+0.23	56.42	6.76		10.34
1 Lacertæ		12	31.86	−0.14	+0.25	31.97	42.43	10.46	
31 Pegasi		17	24.06	−0.04	+0.20	24.22	34.53		10.31
Piazzi XXII. 113		24	4.10	−0.12	+0.23	4.21	14.48	10.27	
39 Pegasi		28	35.01	−0.07	+0.21	35.15	45.50		10.35
Piazzi XXII. 158		31	49.30	−0.07	+0.21	49.44	0.40	10.96	
10 Lacertæ		35	40.19	−0.15	+0.26	40.30	50.84		10.54
η Pegasi		39	10.16	−0.11	+0.23	0.28	20.74	10.46	
λ Pegasi		42	32.61	−0.08	+0.22	32.75	43.05		10.30
π Cephei	23	5	54.62	−0.70	+0.76	54.68	5.34	[10.66]	
130 Heis Pegasi		11	50.53	−0.09	+0.22	50.66	1.05		10.39
τ Pegasi		16	29.27	−0.08	+0.22	29.41	39.96	10.55	
υ Pegasi		21	10.86	−0.08	+0.22	11.00	21.49		10.49
70 Pegasi		24	52.56	−0.04	+0.20	52.72	3.21	10.49	
72 Pegasi		29	47.46	−0.11	+0.23	47.58	58.18		10.60
153 Heis Pegasi		32	21.00	−0.12	+0.24	21.12	31.63	10.51	
γ Cephei		36	15.68	−0.82	+0.89	15.75	26.58		[10.83]

October 20, 1878. First group. Clamp west.

Star's name.	T.			$n \tan \delta$.	$c \sec \delta$.	T′.	A. R.	$dt + m + 2^m$.	
								S.	C.
	h.	m.	s.	s.	s.	s.	s.	s.	s.
λ Cephei	20	14	44.16	−1.07	−0.91	42.18	55.33	[13.15]	
39 Cygni		20	49.38	−0.15	−0.24	48.99	1.85		12.86
41 Cygni		26	14.83	−0.14	−0.23	14.46	27.30	12.84	
ε Delphini		29	13.92	−0.05	−0.20	13.67	26.17		12.50
β Delphini		33	40.51	−0.06	−0.21	40.24	52.74	12.50	
δ Delphini		39	36.56	−0.06	−0.21	36.20	48.88		12.59
ε Cygni		43	6.93	−0.16	−0.24	6.53	19.15	12.62	
Piazzi XX. 358		48	7.95	−0.11	−0.22	7.62	20.34		12.73
32 Vulpeculæ		51	12.26	−0.11	−0.22	11.93	24.51	12.58	
61 Cygni pr	21	3	16.35	−0.19	−0.25	15.91	28.63		12.72
ζ Cygni		9	35.11	−0.14	−0.23	34.74	47.58	12.84	
υ Cygni		14	44.62	−0.16	−0.24	44.22	57.05		12.83
1 Pegasi		18	17.47	−0.08	−0.21	17.18	29.88	12.70	
7444		20	59.82	−0.12	−0.22	59.48	12.09		12.61
70 Cygni		24	13.41	−0.18	−0.25	12.98	25.88	12.90	
Gr. 3511		30	11.09	−1.36	−1.15	8.58	21.08		[12.50]

October 20, 1878. Second group. Clamp west.

Star's name.	T.			$n \tan \delta$.	$c \sec \delta$.	T′.	A. R.	$dt + m + 2^m$.	
								S.	C.
	h.	m.	s.	s.	s.	s.	s.	s.	s.
π^2 Pegasi	22	6	24.92	−0.15	−0.24	24.53	37.56	13.03	
Piazzi XXII. 32		9	54.14	−0.13	−0.23	53.78	6.77		12.99
1 Lacertæ		12	30.03	−0.18	−0.25	29.60	42.45	12.85	
81 Pegasi		17	21.98	−0.05	−0.20	21.73	34.52		12.79
39 Pegasi		28	32.86	−0.09	−0.21	32.56	45.51	12.95	
Piazzi XXII. 158		31	47.68	−0.09	−0.21	47.38	0.41	13.03	
10 Lacertæ		85	37.98	−0.19	−0.26	37.53	50.83		13.30
η Pegasi		39	7.99	−0.14	−0.23	7.62	20.73	13.11	
λ Pegasi		42	30.38	−0.10	−0.22	30.06	43.10		13.04
ι Cephei		47	12.04	−0.53	−0.48	11.03	23.84	[12.81]	
β Pegasi		59	42.84	−0.12	−0.23	42.49	55.52		13.03
56 Pegasi	23	3	1.40	−0.11	−0.22	1.07	14.21	13.14	
π Cephei		5	53.62	−0.88	−0.76	51.98	5.29		[13.31]
130 Heis Pegasi		11	48.24	−0.11	−0.22	47.91	1.06	13.15	

The chronometer used was Negus 1481; the transit instrument, Würdemann 31; its line-intervals from the center, $3^s.538n$, where n is a whole number less than 15. The lines were ruled on glass, 25 in number, in 5 groups; I could detect no deviation from regularity in them, and always employed symmetrical lines. The value of one level division used was 1″.0; later Mr. Rock found 0″.977.

The personal equation with Mr. Rock was determined by means of a personal equation apparatus. Its value will be found in the report on the longitude of Fort Bliss. This also was neglected; it was too uncertain.

The calculations of latitude for the different stations were made with the help of the catalogue of 2,018 stars. Stars outside of its range were taken from the American Ephemeris as now corrected; that is, applying to the apparent places of the volume for 1878 the corrections given in that for 1881; or from the German catalogue of 539 stars, using the last revision of its places; when a star occurs in both these catalogues, a mean was taken.

For other stars the most modern authorities were reduced, after the manner of the catalogue of 2,018 stars. In a very few cases no accurate place of the star could be found; this refers chiefly to such stars in the new Coast Survey rough-working list as had not been observed of late years, and had been excluded from the catalogue of 2,018 stars for that reason.

Whenever the result of all the observations upon a pair or combination of stars seemed discrepant, the declinations were thoroughly revised. No correction was found in this way to the catalogue of 2,018 stars; in some cases new observations have been lately published, but no star was found to need any correction which could sensibly affect the results.

The combinations of more than two stars gave some trouble. In one case there are three north stars and four south, which would give twelve pairs, but with a weight of $\frac{2.3.4}{3+4}=3\frac{3}{7}$ only. In this and all similar cases I treated the whole combination as one pair; that is, I inserted in the blank provided the half sum of the mean of the declinations of north stars, and of the mean of the declinations of south stars, and gave the result a higher weight. This is the only logical method. Of course in all these cases I took pains to see that the micrometer readings were such as agreed with the known differences of declinations of the stars, before taking the means.

The notes upon the stations were prepared by the observers.

I remain, sir, very respectfully, yours,

T. H. SAFFORD.

Capt. G. M. WHEELER,
United States Engineers, in charge.

ASTRONOMICAL STATION AT WALLA WALLA, WASH. TER., 1878.

GEOGRAPHICAL POSITION.

Latitude 46° 3′ 55.″89.

Longitude —— ——— ———.

Barometric altitude of observatory above sea level (monument), 1,033.5 feet.

In reducing the observations for time made at Walla Walla discrepancies were found which could not be explained for lack of time. The discussion of the longitude is here omitted.

The pier, of cemented brick, from which the observations were made for the astronomical determination of this station, is situated in block No. 9, known as jail-square, 57 feet from the center of Fifth street, and 211 feet in a straight line to a street monument in the center of Main and Fifth streets (see plate herewith). The location was objectionable on account of dust, smoke, jar and noise, but was unavoidable, there being no other place where the pier would probably be protected, and at the same time afford the necessary telegraphic facilities.

In erecting the pier the magnetic needle, variation 20¼° east, was used; the transit, however, showed it to be largely out of the prime vertical. The unreliability of the needle in this instance is due, doubtless, to the components of the soil, which is here constituted largely of bowlders charged with magnetic iron.

WALLA WALLA AND ITS SURROUNDINGS.

Wallula is a clear, rapid creek heading in the Blue Mountains and running westward to the Columbia River. In a dish-shaped valley and some 30 miles from the mountains lies Walla Walla, on both sides of the creek. Its population is some 3,000. It is a place of large business in all branches of trade, and is the objective point for the torrent of emigration at present heading for the Pelouse County.

By irrigation the soil gives evidence of great fertility, producing not only small grain but the best of all sorts of vegetables and the finest corn, probably, west of the Mississippi Valley. Fruit is also in abundance, of fine quality, not only apples, pears and the like, but also grapes. The city is regularly laid out, and both as to extent of squares and ornamentation is not unlike the best settlements of Mormondom. The streets are planted with Lombardy poplars, which have made a rapid growth and contribute much both to the appearance and the comfort of the place. They have been irrigated up to the present time, but it is believed that they will eventually root deeply enough in the loose soil to secure sufficient moisture.

METEOROLOGICAL CONDITIONS.

Three weeks were occupied in the determination, in latitude and longitude, of this station, from August 8 to August 29. There were many electrical phenomena and some clouds to occasion delay, but there was no rain, nor had there been any to bless this land of dust since the March previous.

Observations were made August 10, 12, 13, 14, 16, 18, 19, 24, and 25. The 15th, 17th, 20th, 21st, 22d, and 23d were cloudy—a week out of three, yet no rain. The night of August 22, while loitering at the observatory tent, waiting for the clouds to disperse, a "chinook" was felt, but it was of brief duration. The "chinook" is a hot wind that comes from the sea; it is common in winter, and is particularly remarkable for the rapidity of its softening action upon the snow and the frost-locked land.

TELEGRAPHIC COMMUNICATION.

The connection was made with the Ogden Observatory by way of Boise City and Winnemucca. That portion of the line between Walla Walla and Winnemucca was in charge of Professor Speed, it having been but recently put in order for military purposes. It was a perpetual source of delay and worry; men had to be kept out constantly looking after it. The poles were rotten and gave way daily from one cause or another and the wire was seldom or never working 12 hours consecutively.

Length of circuit about 989 miles.

METHOD OF OBSERVATION.

Observations were made with eye and ear, Mr. G. M. Dunn recording, and giving other efficient service in addition to his meteorological observations. The chronometer for exchange of signals was taken to the telegraphic office, distant some three squares.

INSTRUMENTS.

Z. M. (Würdemann, No. 16). This instrument is old and much worn, and if at its best would be too small for latitude work in the atmosphere of Walla Walla.

Chronometer Negus No. 1511 was used and had a very fair rate, despite the necessarily rough usage it received in the stage trip from Redding to Roseburg.

Wire-intervals (Lamp east).

1–3, 43.61
2–3, 21.87
3–4, 21.29
3–5, 43.53

ne division of striding-level	1.″14
ne division of zenith telescope-level	1.″44
One revolution of micrometer:	
ssumed, including refraction	81.″00
orrected after discussion by	0.″1215*
	80.″8785
ubtract refraction	0.″025
inal value	80.″85 nearly.

*—0.″09 for every minute.

ean place of stars for 1878.0 used for the determination of latitude of Walla Walla, Wash.

o. of pair.	No. B. A. C.	Class.	R. A. h.	m.	s.	Declination. °	′	″
	5840	A	17	11	30	63	0	49.7
	(1)	C	17	14	0	28	57	4.9
	5874	B	17	17	43	40	5	42.5
	5937	A A	17	27	41	52	23	32.5
	5972	A	17	32	27	68	12	45.0
	6005	A	17	38	21	24	22	55.4
	5975	B	17	33	26	48	39	26.4
	6013	C	17	39	29	44	8	18.3
	(2)	C	17	48	38	46	40	32.7
	(3)	C	17	53	13	45	22	2.2
	(4)	C	17	55	23	45	29	3.3
	6109	B	17	56	27	45	30	28.2
	6162	C	18	3	48	43	26	52.5
	(5)	C	18	11	50	49	6	54.4
	6218	B	18	13	15	40	53	22.2
	6246	B	18	17	5	51	17	41.5
	6258	C	18	18	37	51	14	33.5
	6252	B	18	18	4	49	39	59.5
	(6)	B	18	20	24	42	24	7.0
	(7)	C	18	21	34	26	23	24.7
	(8)	C	18	21	40	26	22	42.2
	6316	A	18	25	38	65	29	16.8
	(13)	C	18	30	52	65	20	19.3
	(9)	A	18	35	50	65	22	45.9
	(10)	B	18	39	12	39	10	43.1
	6390	A	18	40	18	39	32	35.9
	6391	A	18	40	20	39	29	9.0
	6419	A	18	43	59	52	51	16.6
	6452	B	18	48	51	52	49	4.2
	(14)	C	18	51	24	40	1	12.5
	6493	C	18	54	47	40	30	45.8
	(15)	C	18	56	19	40	30	49.1
	6530	C	18	59	15	52	5	5.0
	6551	B	19	2	11	53	12	35.4
	6581	A	19	9	36	38	56	12.7
	6620	C	19	15	41	62	50	10.4
	6648	B	19	19	19	29	23	1.9
	6681	C	19	23	34	57	46	55.2
	6698	A	19	27	14	34	11	40.3
	(11)	C	19	28	30	55	28	21.5
	6722	A	19	31	25	36	40	29.6
	6748	B	19	35	57	54	41	15.8
	6771	A	19	30	53	37	3	37.7
	6780	C	19	40	52	57	43	33.9
	6777	B	19	41	19	34	42	59.2
	6779	A A	19	41	10	44	50	1.5
	6799	C	19	43	53	47	36	24.6
	6810	A	19	45	49	22	18	3.7
	6836	A A	19	48	35	69	57	25.7
	6879	A	19	56	5	27	25	2.9
	6905	A	20	0	11	64	28	46.0
	6930	C	20	3	12	63	32	23.0
	6957	A	20	9	14	28	19	34.2
	6990	A	20	13	17	37	39	15.5
	7035	C	20	19	52	54	16	48.4
	7055	C	20	22	23	54	17	7.2
	7098	A	20	27	32	62	35	3.5
	7152	A	20	33	58	29	54	28.7
	7166	C	20	35	51	55	34	32.4
	7213	A A	20	42	30	36	2	35.2
	7297	A	20	55	15	39	46	34.9
	7332	C	21	0	4	52	48	1.8
	7401	B	21	13	35	55	17	9.5
	7462	A	21	22	23	36	35	14.0
	7483	C	21	26	17	52	25	17.4
	7489	C	21	27	21	52	4	55.6
	7521	A	21	32	3	39	51	57.7
	7555	C	21	36	41	54	19	4.2
	7566	A	21	38	23	37	43	32.5
	(12)	B	21	38	34	37	44	50.3
	7614	B	21	46	2	38	57	57.5
	7637	A	21	49	3	53	25	21.7
	7696	A	21	59	56	59	13	24.2
	7698	B	22	0	14	59	16	31.8
	7721	A	22	3	49	32	34	36.4
	7731	A	22	4	34	32	34	47.9
	7746	B	22	6	26	50	13	15.2
	7770	C	22	9	37	42	20	58.3

[1] Sd. 645.
[2] Sd. 714.
[3] Gr. 2491.
[4] Sd. 726.
[5] Sd. 754.
[6] Sd. 759.
[7] Sd. 781.
[8] Sd. 782.
[9] Sd. 804.
[10] Sd. 812.
[11] Sd. 956.
[12] Sd. 1304.
[13] Gr. 2617.
[14] Gr. 2715.
[15] Gr. 2735.

Observations and computations for latitude, Walla Walla, Wash.

Date.	Number of star.	Micrometer readings.	Level.		Half sum of declination.	Corrections.			Latitude.
			N.	S.		Micr. and refr.	Level.	Merid.	
					° ′ ″	′ ″	″		° ′ ″
August 13, 1878	6551	5.595	9	26	46 4 34.8	− 0 12.0	−3.6	....	46 4 15. 2
	6581	5.200	22	13					
	6629	14.005	17	18	46 11 16.9	− 7 3.6	−4.5	....	4 8. 8
	6648	3.545	13	22					
	(11)	8.415	19	16.5	46 4 36.9	− 35.8	−3.4	....	3 57. 7
	6722	7.530	13	23					
	6748	*−1.115	20	16	45 52 38.4	+11 23.0	−3.6	....	3 57. 8
	6771	16.980	12	24					
	6810	3.835	14	22	46 7 55.8	− 3 53.9	−3.6	....	3 58. 3
	6836	9.610	18	18					
	6930	0.850	20	16	45 56 10.7	+ 7 50.4	−3.7	....	3 57. 4
	6957	12.465	......	......					
August 14, 1878	5840	5.755	16.5	16	45 59 3.4	+ 4 48.8	+0.4	....	3 52. 6
	(1)	12.885	16.5	16					
	5874	0.240	18	14	46 14 44.6	−10 51.2	+1.1	....	3 54. 5
	5937	16.320	16	17					
	5975	30.855	14	20	46 24 0.21	−20 5.7	+0.4	....	3 54.
	6013	1.085	20	13					
	(2)	16.110	17	17	46 4 0.4	− 7.0	+0.7	....	3 54.
	(3)	19.790	......	......					
	(4)	14.535	......	......					
	6109	13.490	18	16					
	6162	2.895	18	16	46 17 2.5	−13 7.5	+0.5	....	3 55.
	(5)	22.340	16.5	17					
	6391	7.680	21.5	13	46 9 50.0	− 5 56.3	+0.9	....	3 54.
	6419	17.305	14	20					
	6452	15.650	......	......					
	6551	13.690	21	14	46 4 35.1	− 39.7	+0.7	....	3 56. 1
	6581	12.710	15	20					
	6629	18.540	20	15	46 11 17.1	− 7 24.1	+0.9	....	3 53.9
	6648	7.575	16	18.5					
	6681	12.390	20	15	45 59 29.2	+ 4 26.1	+2.2	....	3 57.5
	6698	18.960	18	17					
	6748	8.200	21.5	14	45 52 38.7	+11 13.7	+1.3	....	3 53.7
	6771	24.835	15.5	19.5					
	6779	10.940	10.5	25.0	46 13 25.2	− 9 27.8	+0.2	....	(?)3 57.6
	6799	24.960	25	15					
	6879	22.200	15	20	45 57 6.5	+ 6 51.1	+0.9	....	3 58.5
	6905	12.050	21.5	14					
	6930	16.560	17	18.5	45 56 11.0	+ 7 45.3	+0.9	....	3 57.2
	6957	28.050	20	16					
	6990	18.365	17	19	45 58 19.5	+ 5 36.8	+2.2	....	3 58.5
	7035	9.945	22	14					
	7055	10.155	......	......					
	7098	25.545	21.5	14	46 14 59.1	−11 5.2	+2.2	....	3 56.1
	7152	9.120	17	18.5					
August 17, 1878	6551	13.320	21	18	46 4 35.8	− 40.1	0.0	....	3 55.7
	6581	12.330	18	21					
	6629	19.098	20	18	46 11 17.8	− 7 22.8	+0.4	....	46 3 55.4
	6648	9.065	19	20					

* Should be 0.115.

There is a manifest error in the level reading. I have conjectured 25 10 to be the proper numbers for 6799 S.

[2] Sd. 714. [5] Sd. 754. [6] Sd. 779. [10] Sd. 812. [11] Sd. 956.

Observations and computations for latitude, Walla Walla, Wash. Ter.—**Continued.**

Date.	Number of star.	Micrometer readings.	Level.		Half sum of declination.	Corrections.			Latitude.
			N.	S.		Micr. and refr.	Level.	Merid.	
					° ′ ″	′ ″	″		° ′ ″
ust 17, 1878........	6681 6698	9. 478 16. 080	22 17. 5	17 22	45 59 30. 0	+ 4 27. 4	+0. 2	....	46 3 57. 6
	6748 6771	7. 900 24. 620	24 14	15 25	45 52 39. 5	+11 17. 2	—0. 7	....	3 56. 0
	6810 6836	11. 558 17. 560	15 24	24 15	46 7 56. 9	— 4 3. 1	0. 0	....	3 53. 8
	6879 6905	20. 230 10. 105	13. 5 30	25 7	45 57 7. 3	+ 6 50. 1	+4. 1	....	61. 5
ust 18, 1878........	5972 6005	24. 335 3. 475	22 14	15 22	46 17 57. 5	—14 4. 8	—0. 4	....	3 52. 3
	(7) 6109	18(?). 255 10(?). 660	18 18	18 18. 5	46 5 39. 5	— 1 45. 1	—0. 2	....	3 54. 2
	6162 (8)	5. 215 25(?). 725	16. 5 19	20 18	46 17 3. 2	—13 10. 2	—0. 9	....	3 52. 1
	6252 (9)	15. 860 17. 525	21. 5 15. 5	16 21. 5	46 2 13. 5	+ 1 7. 4	—0. 2	....	3 [20.7]
	(10) 6391 6390 6419 6452	21. 710 8. 060 5. 475 17. 690 15. 950	.... 15. 5 22	.... 21. 5 15	46 7 21. 0	— 3 25. 4	+0. 4	....	3 56. 0
	6493 6530	3. 515 24. 620	15 22	22 15. 5	46 18 7. 1	—14 14. 8	—0. 2	....	3 52. 1
	6551 6581	12. 350 11. 320	19. 5 19	18 18. 5	46 4 36. 0	— 0 41. 7	+0. 7	....	3 55. 0
	6629 6648	18. 320 7. 440	23. 5 14	14 23. 5	46 11 18. 1	— 7 20. 6	0. 0	....	3 57. 5
	6681 6698	8. 275 14. 825	19 19	18. 5 18	45 59 30. 2	+ 4 25. 3	+0. 5	....	3 56. 0
	(11) 6722	11. 750 10. 670	21 18	17 19	46 4 38. 3	— 0 43. 7	+1. 1	....	3 55. 7
	6748 6771	4. 650 21. 270	21 17	16. 5 20	45 52 39. 8	+11 13. 1	+0. 5	....	3 53. 4
	6780 6777	12. 170 26. 340	....	....	46 13 29. 5	— 9 33. 9	+0. 5	....	3 56. 1
	6810 6836	15. 620 21. 610	15. 5 24	22 14	46 7 57. 1	— 4 2. 6	+1. 3	....	3 55. 8
	6879 6905	21. 965 11. 830	16 21	21 17	45 57 7. 6	+ 6 50. 5	—0. 4	....	3 57. 7
	6930 6957	12. 380 23. 870	20 18	18 20	45 56 12. 1	+ 7 45. 3	0. 0	....	3 57. 4
	6990 7035 7055	21. 138 12. 705 12. 885	15. 5 24	22 14	45 58 20. 7	+ 5 37. 9	+1. 3	....	3 59. 9
	7098 7152	26. 475 10. 060	21 18	18 20	46 15 0. 2	—11 4. 8	+0. 4	....	3 55. 8
	7166 7213	0. 885 23. 370	22 16	16. 5 22	45 48 48. 4	+15 10. 6	—0. 2	....	3 58. 8
	7297 7332	4. 245 26. 430	17 20. 5	21 18	46 17 33. 3	—13 37. 5	—0. 5	....	3 55. 3
	7401 7462	7. 905 19. 025	22 17	16. 5 21. 5	45 56 27. 0	+ 7 30. 4	+0. 4	....	46 3 57. 8

Observations and computations for latitude, Walla Walla, Wash. Ter.—**Continued.**

Date.	Number of star.	Micrometer readings.	Level.		Half sum of declination.	Corrections.			Latitude.
			N.	S.		Micr. and refr.	Level.	Merid.	
					° ′ ″	′ ″	″		° ′ ″
August 18, 1878........	7483	21.700	......	......	46 3 47.5	+ 0 7.7	+0.5	....	46 3 55.7
	7489	6.575	21	18					
	7521	14.328	18.5	20					
	7555	16.785	22	16.5	46 1 33.8	+ 2 22.2	+1.3	....	3 57.3
	7566	20.295	18	20					
	7614	9.720	18	20	46 11 55.1	− 7 57.3	−0.7	....	3 57.1
	7637	21.505	19.5	19.5					
	7696	5.830	......	......	45 54 15.8	+ 9 38.7	+0.1	....	3 54.6
	7698	6.105	......	......					
	7721	19.120	......	......	45 55 55.4	+ 7 59.9	+0.1	....	3 55.4
	7731	18.955	......	......					
	7746	31.015	18	21	46 17 23.8	−13 20.5	+0.9	....	64.2
	7770	11.250	22	16.5					
August 20, 1878........	(10)	24.130	......	......	46 7 21.4	− 3 24.6	+0.5	....	3 57.3
	6391	10.440	......	......					
	6390	7.880	16.5	20					
	6419	20.020	21	16					
	6452	18.385	......	......					
	6990	18.090	15	22.5	45 58 21.3	+ 5 38.7	+0.9	....	60.9
	7035	9.660	24	14					
	7055	9.895	......	......					
	7098	20.978	21.5	16.5	46 15 0.8	−11 6.3	−0.2	....	3 54.3
	7152	4.525	16	21.5					
	7297	3.465	16.5	21.5	46 17 33.9	−13 41.3	+0.4	....	3 53.0
	7332	23.745	22	16					
	7401	7.635	21	17.5	45 56 27.6	+ 7 28.5	+0.5	....	3 56.6
	7462	18.710	18	20					
	7483	22.710	......	......	46 3 48.1	+ 0 9.5	−0.4	....	3 57.2
	7489	7.580	23	16					
	7521	15.380	15	23					
	7555	12.970	24.5	14	46 1 53.9	+ 2 3.1	0.0	....	3 57.0
	7566	16.470	......	......					
	(12)	15.550	14	24.5					
	7614	7.390	16.5	22	46 11 55.8	− 8 3.3	+0.7	....	3 53.2
	7637	19.323	23	15.5					
	7696	5.145	......	......	45 54 16.5	+ 9 38.9	+0.5	....	3 55.9
	7698	7.380	......	......					
	7721	19.440	......	......	45 55 56.1	+ 8 3.6	+0.5	....	60.2
	7731	19.320	......	......					
	7746	22.940	20.5	18.	46 17 24.4	−13 28.0	+0.4	....	3 56.8
	7770	2.990	18	18.5					
August 21, 1878........	7098	23.425	22.5	16.5	46 15 1.1	−11 1.0	−4.0	....	3 56.1
	7152	7.105	11	28					
	7166	2.385	22.5	16.5	45 48 49.3	+15 12.0	−4.0	....	3 57.3
	7213	24.903	11	28					
	7297	3.715	15.5	24	46 17 34.3	−13 40.9	−2.0	....	3 51.4
	7332	23.985	21	18					
	7401	8.035	23	17	45 56 28.0	+ 7 28.7	−0.9	....	3 55.8
	7462	19.115	15.5	24					
	7483	23.400	......	......	46 3 48.4	+ 0 8.1	−1.8	....	3 54.7
	7489	8.290	21.5	18					
	7521	16.045	15.5	24					
	7555	15.355	21	18	46 1 34.8	+ 2 22.6	−3.1	....	46 3 54.3
	7566	18.875	14	25.3					

Observations and computations for latitude, Walla Walla, Wash. Ter.—Continued.

Date.	Number of star.	Micrometer readings.	Level.		Half sum of declination.	Corrections.			Latitude.
			N.	S.		Micr. and refr.	Level.	Merid.	
					° ′ ″	′ ″	″		° ′ ″
gust 21, 1878........	7614	12.225	18	21	46 11 56.1	− 7 57.9	−3.4	....	46 3 54.8
	7637	24.025	16.5	23					
	7696	9.810	......	......	45 54 16.8	+ 9 41.6	[−3.2]	....	3 55.2
	7698	12.175	22	18					
	7721	24.170	......	......	45 55 56.4	+ 7 58.9	[−3.2]	....	3 52.1
	7731	24.000	......	......					
gust 23, 1878........	5874	4.050	12.5	19	46 14 45.7	−10 53.9	+4.1	....	3 55.9
	5937	20.195	24	8					
	5972	27.630	19	13	46 17 58.1	−14 6.2	+1.6	....	3 53.5
	6005	6.760	15.5	17					
	(2)	18.355	16	17	46 4 1.8	− 0 9.2	+2.9	....	3 53.5
	(3)	22.945	6	......					
	(4)	16.750	......	......					
	6109	15.690	21	12					
	6162	11.355	15.5	18	46 17 4.1	−13 12.4	+2.0	....	3 53.7
	(5)	28.920	20.5	12.5					
	6218	15.415	14	19	46 4 8.8	− 0 16.8	+1.4	....	3 53.4
	6258	15.830	21.5	12.5					
	(8)	22.160	14.5	19	45 52 54.7	+11 2.0	+3.2	....	3 59.9
	(9)	5.813	24	10.5					
	(10)	22.220	......	......	46 7 22.0	− 3 31.1	[+3.0]	....	3 53.9
	6390	8.530	......	......					
	6391	5.975	......	......					
	6419	18.268	24	11					
	6452	16.640	......	......					
	6780	8.825	......	......	46 13 30.8	− 9 41.0	[+3.0]	....	3 52.8
	6777	23.170	......	......					
	6810	9.130	15	20	46 7 58.3	− 4 7.9	+3.2	....	3 53.6
	6836	16.250	25	11					
	6879	21.240	13.5	22	45 57 8.8	+ 6 44.2	+3.1	....	3 56.1
	6905	16.260	26	9					
	6930	12.828	19	16.5	45 56 13.4	+ 7 40.6	+3.4	....	3 57.4
	6957	24.200	21	14					
	6990	24.715	14.5	20.5	45 58 22.2	+ 5 29.8	+1.4	....	3 53.4
	7035	16.455	25	15					
	7055	69.690	......	......					
	7098	25.010	21	15	46 15 1.7	−11 10.5	+3.4	....	3 54.6
	7152	9.455	19	15.5					
	7166	6.115	18	18	45 48 50.1	+15 3.1	+3.4	....	3 56.6
	7213	28.413	22.5	13					
	7297	5.670	16	20	46 17 34.9	−13 43.9	+2.9	....	3 53.9
	7332	26.013	24	12					
	7401	9.480	20.5	15	45 56 28.6	+ 7 24.5	+3.2	....	3 56.3
	7462	20.455	19.5	16					
	7483	24.173	......	......	46 3 49.1	+ 0 1.2	+3.4	....	3 53.7
	7489	9.050	20	16					
	7521	16.640	20.5	15					
	7555	15.790	24	12	46 1 35.4	+ 2 16.9	+3.2	....	3 55.5
	7566	19.170	16.5	19.5					
	7614	9.620	18	18	46 11 56.7	− 8 6.6	+4.1	....	3 54.2
	7637	21.635	24	12.5					
	7698	11.490	21	15	45 55 54.1	+7 57.5	+3.4	....	46 3 55.0
	7721	23.358	20	16.5					
	7731	23.200	......	......					

Observations and computations for latitude, Walla Walla, Wash. Ter.—Continued.

Date.	Number of star.	Micrometer readings.	Level.		Half sum of declination.	Corrections.			Latitude.
			N.	S.		Micr. and refr.	Level.	Merid.	
					° ′ ″	′ ″	″		° ′ ″
August 23, 1878	7746	27.055	24	12.5	46 17 25.2	−13 34.1	+3.1	....	46 3 54.2
	7770	6.953	16.5	19.5					
August 24, 1878	6218	14.375	18	14	46 4 55.9	− 1 1.0	+2.2	....	3 57.1
	6246	17.050	......	......					
	6258	14.710	18	16					
	(7)	21.180	......	......	45 53 47.6	+10 7.0	+2.5	....	3 57.1
	(8)	21.680	15.5	18					
	6316	10.250	......	......					
	(13)	3.725	22	12.5					
	(9)	5.355	......	......					
	(10)	22.750	......	......	46 7 22.2	− 3 29.9	+3.6	....	3 55.9
	6391	9.070	......	......					
	6390	7.455	14	80					
	6419	18.755	25	9					
	6452	17.125	......	......					
	(14)	26.078	......	......	46 13 13.8	− 9 21.2	+1.8	....	46 3 53.9
	6493	4.140	......	......					
	(15)	4.100	17	18					
	6530	25.295	20	14					
	6551	14.590	20	15	46 4 37.4	− 0 46.8	+3.4	....	3 54.0
	6581	13.435	19.5	15					
	6629	19.560	21	14	46 11 19.4	− 7 28.7	+3.8	....	3 54.5
	6648	8.480	19.5	15					
	6681	8.643	22	13.5	45 59 31.6	+ 4 23.7	+3.4	....	3 58.7
	6698	14.155	18	17					
	(11)	17.060	21	14	46 4 39.7	− 0 47.9	+3.4	....	3 55.2
	6722	15.878	18.5	16					
	6748	4.535	18.5	16.5	45 52 41.3	+11 11.7	+4.7	....	3 57.7
	6771	21.120	23	12					
	6780	6.470	......	......	46 13 31.0	− 9 40.0	[+3.0]	....	3 54.0
	6777	20.790	......	......					
	6810	10.250	15	20	46 7 58.6	− 0 4.6	+1.3	....	3 55.3
	6836	16.290	22	13.5					
	6879	19.918	15.5	19.5	45 57 9.1	+ 6 45.9	+1.8	....	3 56.8
	6905	9.895	22	13					
	6930	10.030	20	15	45 56 13.7	+ 7 40.7	+2.7	....	3 57.1
	6957	21.405	19	16.5					
	6990	15.820	14	22	45 58 22.4	+ 5 31.1	+2.7	....	3 56.2
	7035	12.520	......	......					
	7055	12.770	25.5	10					
	7098	24.440	15	21	46 15 2.0	(?)*	+3.6	....	(?)
	7152	7.070	26	10					
	7166	2.640	19	16.5	45 48 50.2	+15 1.5	+3.1	....	46 3 54.8
	7213	24.900	20	14					

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fear some complicated error; perhaps 7.930 should be the reading for 7152; which gives 3′ 50″.9.

Discussion of latitude, Walla Walla.

Combination.	Number observations.	Number stars.	Latitude.	Correction to micrometer.	Combination.	Number observations.	Number stars.	Latitude.	Correction to micrometer.
			° ′ ″					° ′ ″	
1	1	2	46 3 52.6	− 0.43	17	3	2	46 3 54.30	+ 0.87
2	2	2	55.20	+ 0.97	18	1	2	57.6	+ 0.85
3	2	2	52.95	+ 1.27	19	5	2	55.36	+ 0.36
4	1	2	54.9	+ 1.81	20	5	2	58.12	− 0.61
5	3	4	54.60	+ 0.06	21	5	2	57.30	− 0.69
6	3	2	53.77	+ 1.19	22	5	3	57.78	− 0.50
7	2	2	55.25	+ 0.06	23	6	2	55.38	+ 1.00
8	1	2	[4 1.2?]	− 0.11	24	4	2	56.88	− 1.36
9	2	3	3 58.50	− 0.95	25	4	2	53.40	+ 1.23
10	5	5	55.54	+ 0.36	26	4	2	56.62	− 0.67
11	2	4	53.00	+ 1.06	27	4	3	55.32	− 0.01
12	4	2	55.20	+ 0.06	28	4	3	56.02	− 0.21
13*	4	2	55.32	+ 0.67	29	4	2	54.82	+ 0.72
14	4	2	57.45	− 0.40	30	4	4	56.42	− 0.84
15	3	2	56.20	+ 0.06	31	3	2	46 3 58.40	+ 1.21
16	5	2	55.72	− 1.02					

*Observation of August 13, excluded.

FINAL LATITUDE.

46° 3′ 55″.89 ± 0″.16.

TABLE OF WEIGHTS.

2 stars, 1 obs	0.5	
2 obs	0.75	
3–6 obs	1.00	
3 stars	1.33	for 3 to 6 observations { Diminished in above proportion for less.
4 stars	2.	
5 stars	2.4	

ASTRONOMICAL STATION AT THE DALLES, OREGON, 1878.

GEOGRAPHICAL POSITION.

Latitude, 45° 36′ 17″.78.
Longitude, 121° 12′ 20″.47.
Barometric altitude of observatory above sea-level (monument) 179.8 feet.

The point selected for the determination in The Dalles was on the bluff of the lava bed, under the shadow of which are the Steam Navigation Company's offices and workshops.

The pier was of cemented brick, and in a position not likely to be disturbed, unless by some irrational wantonness. From here one can not only overlook the whole city, but have an unobstructed view of the lofty and snow-covered cone of Mount Hood; and, but for a mountain ridge just across the Columbia River, Mount Adams would also be visible. From the pier the northwest corner section 3, township 1 north, range 13 east bears N. 33° W., distant 47½ feet; and to the south side of Main street, if it were prolonged, the distance is 81¼ feet. (See plate herewith.) The meridian was marked on the north near the bluff facing the Columbia River, by an iron pin driven into the ground and then covered by a conical pile of rocks 6 feet wide and 4 feet high; southward, on a large natural mound (which was once a part of the military reservation of old Fort Dalles), it was indicated in the same way.

DALLES CITY AND SURROUNDINGS.

The Dalles, or Dalles City, in the language of its incorporation, is situated at the mouth of Mill Creek, a very considerable distance below the main part of the rapids of the Columbia River, from which it takes its name. It is a strangely selected spot for a city, for what is not lava-bed is for the most part sand. Once there was a level and fertile valley between the city and the foot of the rapids, but this is now almost entirely covered with sand dunes. The wind that pours up the cañon, that sets in at the mouth of Mill Creek, like water through a funnel, is apparently the cause of all this sand in and about the city. Despite the forbidding character of the location, Dalles City is a picturesque, go-ahead town, having many fine stores and pleasant residences with their charming fruit gardens.

METEOROLOGICAL CONDITIONS.

It took no less than four weeks to complete this station, from August 29 to September 25. Arrangements for observations were ready on the 30th. September 1, however, a violent wind carried everything in the shape of tent and other equipments to the ground, making it necessary to put up a substantial frame-work.

Observations were made, or it was possible to make them, September 2, 3, 4, 5, 6, 7, 8, and 9, although there was much embarrassment from the wind.

From September 10 to 19, inclusive, the atmosphere was so full of smoke driven from the burning Cascade Mountains that no observations could be made. A few of the very largest stars could sometimes be faintly seen. During this time the sun was stripped of its power and stood in the heavens as a great blood-red rayless orb; the moon had the same general appearance by night; the wind blowing all the while eastward and sometimes violently. From the 19th to the 25th the weather was for the most part favorable, if the wind be excepted.

TELEGRAPHIC COMMUNICATION.

The Western Union Office and that of the Oregon Steam Navigation Company not being connected in Portland, an effort was made at first to get Ogden by way of Walla-Walla, Boise City, and Winnemucca. The most patient perseverance for many nights brought success but once in this direction, September 5.

The offices in Portland having been connected, the rest of the signal exchanges were made by Portland and San Francisco, that circuitous but expeditious route.

Length of circuit via Walla-Walla, about 1,144 miles; via Portland about 1,500 miles.

METHOD OF OBSERVATION.

Mode of observation the same as at Walla-Walla; that is, eye and ear. The chronometer did not have to be taken so far, but the climbing up and down the bluff was anything but a safe or pleasant operation.

INSTRUMENTS.

Instruments the same as at Walla-Walla. No. 16 is an old instrument and has been put to much service in many places, but the roughest usage it ever had, it received probably from the wind and sand of Dalles City, Oregon.

Tabulation of stars used for determination of time at Ogden, Utah, and The Dalles, Oreg.

Name of star.	Ogden.					The Dalles, Oreg.				
	Sept. 5.	Sept. 17.	Sept. 20.	Sept. 21.	Sept. 22.	Sept. 5.	Sept. 17.	Sept. 20.	Sept. 21.	Sept. 22.
o Herculis	×	......	......	......	......	......	......	......	......	......
A Herculis	×	......	......	......	......	......	......	......	......	......
204 Heis Herculis	×	......	......	......	......	......	......	......	......	......
κ Lyræ	......	......	×	......	×	......	......	......	......	......
109 Herculis	......	......	×	......	×	......	......	......	......	×
χ Draconis	×	......	......	×	×	......	......	×	......	×
9 Heis Lyræ	×	......	×	......	×	......	......	......	......	......
11 Heis Lyræ	×	......	......	......	......	......	......	......	......	......
3 Heis Scuti	......	......	......	......	......	......	......	×	......	......
α Lyræ	......	......	×	×	×	......	......	×	......	×
Groom. 2655	×	......	......	......	......	......	......	......	......	......
110 Herculis	......	......	......	......	......	......	......	×	......	×
β Lyræ	......	......	......	×	......	......	......	×	......	×
o Sagittarii	......	......	......	......	......	......	......	×	......	×
δ^2 Lyræ	......	......	......	×	......	......	......	......	......	......
γ Lyræ	×	......	×	×	×	......	......	×	......	×
16 Lyræ	×	......	......	......	......	......	......	......	......	......
ζ Aquilæ	......	......	×	......	×	......	......	×	......	×
ι Lyræ	......	......	×	......	×	......	......	......	......	......
25 Hev. Camelopard., S. P	×	......	......	......	......	......	......	......	......	......
19 Lyræ	......	......	×	......	×	......	......	......	......	......
δ Draconis	......	......	×	......	×	......	......	×	......	×
θ Lyræ	×	......	......	......	......	......	......	......	......	......
τ Draconis	×	......	×	×	×	......	......	......	......	......
δ Aquilæ	......	......	......	......	......	......	×	×	×	×
4 Cygni	×	......	......	×	......	......	......	......	......	......
β Cygni	×	......	......	×	......	......	×	×	×	×
κ Aquilæ	......	......	......	......	......	......	×	×	×	×
9 Cygni	......	......	......	×	......	......	......	......	......	......

Tabulation of stars used for determination of time at Ogden, &c.—Continued.

Name of star.	Ogden.					The Dalles, Oreg.				
	Sept. 5.	Sept. 17.	Sept. 20.	Sept. 21.	Sept. 22	Sept. 5.	Sept. 17	Sept. 20.	Sept. 21.	Sept. 22.
φ Cygni	......	......	......	×	......	......	......	......	......	......
28 Heis Cygni	......	......	......	×	......	......	......	......	......	......
γ Aquilæ	......	......	......	......	......	......	×	×	×	×
α Aquilæ	......	......	......	......	......	......	×	......	......	......
ε Draconis	......	......	......	×	......	......	×	×	×	×
γ Sagittæ	......	......	......	......	......	......	×	......	×	......
τ Aquilæ	......	......	......	......	......	......	......	......	×	......
θ Aquilæ	......	......	......	......	......	×	......	......	×	......
α² Capricorni	......	......	......	......	......	×	......	......	......	......
κ Cephei	......	......	......	......	......	......	×	......	......	......
γ Cygni	......	......	......	......	......	×	......	......	......	......
ε Delphini	......	......	......	......	......	×	×	......	......	......
Groom. 3241	......	......	......	......	......	×	......	......	......	......
73 Draconis	×	......	......	......	......	......	......	......	......	......
α Cygni	×	×	......	......	......	×	×	......	......	......
ε Cygni	×	×	......	......	......	×	......	......	......	......
Pi. XX, 358	×	......	......	......	......	......	......	......	......	......
32 Vulpeculæ	×	......	......	......	......	......	......	......	......	......
Br. 2749	×	......	......	......	......	×	......	......	......	......
61 Cygni, pr	......	......	......	......	......	×	......	......	......	......
Pi. XXI, 1	×	......	......	......	......	......	......	......	......	......
77 Draconis	×	......	......	......	......	......	......	......	......	......
ζ Cygni	......	......	......	......	......	×	......	×	×	......
α Cephei	......	×	......	......	......	×	×	×	×	......
1 Pegasi	×	......	......	......	......	......	......	......	......	......
Pi. XXI, 120	×	......	......	......	......	......	......	......	......	......
70 Cygni	×	......	......	......	......	......	......	......	......	......
β Aquarii	......	......	......	......	......	×	×	×	×	......
Groom. 3511	×	......	......	......	......	......	......	......	......	......
ξ Aquarii	......	......	......	......	......	......	......	×	×	......
ε Pegasi	......	×	......	......	......	......	×	......	......	......
11 Cephei	......	......	×	×	......	......	......	×	×	......
μ Capricorni	......	......	......	......	......	......	......	×	......	......
16 Pegasi	......	......	×	×	......	......	......	......	......	......
17 Pegasi	......	......	×	×	......	......	......	......	......	......
79 Draconis	......	......	......	......	......	......	......	......	×	......
20 Pegasi	......	......	×	×	......	......	......	......	......	......
α Aquarii	......	......	......	......	......	......	......	×	......	......
27 Pegasi	......	......	......	×	×	......	......	......	......	......
π Pegasi	......	......	×	......	......	......	......	......	......	......
24 Cephei	......	......	×	×	×	......	......	......	......	......
1 Lacertæ	......	......	......	......	×	......	......	......	......	......
31 Pegasi	......	......	......	......	×	......	......	......	......	......
38 Pegasi	......	......	×	×	......	......	......	......	......	......
Groom. 3804	......	......	×	×	×	......	......	......	......	......
Pi. XXII. 158	......	......	......	......	×	......	......	......	......	......
31 Cephei	......	......	×	×	×	......	......	......	......	......
η Pegasi	......	......	×	×	×	......	......	......	......	......
λ Pegasi	......	......	×	×	×	......	......	......	......	......

The Dalles, September 5, 1878; after signals.

Name of star.	Clamp.	T.			B*b*.	A*a*.	C*c*.	T′.			A. R.			Δ T.
		h.	*m.*	*s.*	*s.*	*s.*	*s.*	*h.*	*m.*	*s.*	*h.*	*m.*	*s.*	*s.*
θ Aquilæ	E.	20	5	8.94	+ 0.02	+ 5.08	+ 1.26	20	5	15.30	20	5	4.46	− 10.84
α Capriconi	E.		11	24.84	+ 0.01	+ 6.10	+ 1.29		11	32.24		11	21.29	10.95
γ Cygni	E.		18	2.22	+ 0.03	+ 0.91	+ 1.64		17	4.80		18	54.18	10.62
ε Delphini	E.		27	32.70	+ 0.02	+ 4.04	+ 1.28		27	38.04		27	26.77	11.27
Gr. 3241	E.		30	51.08	+ 0.07	− 10.14	+ 4.10		30	45.11		30	33.80	11.31
α Cygni	E.		37	28.40	+ 0.03	+ 0.13	+ 1.77		37	30.33		37	19.58	10.75
ε Cygni	E.		41	27.52	+ 0.03	+ 1.75	+ 1.51		41	30.81		41	19.92	10.89
Bradley 2749	W.	20	53	48.24	− 0.33	− 22.94	− 7.31	20	53	17.66	20	53	6.46	11.20
61 Cygni pr.	W.	21	1	40.90	− 0.09	+ 1.15	− 1.60	21	1	40.36	21	1	29.36	11.00
ζ Cygni	W.		7	58.36	− 0.08	+ 2.19	− 1.44		7	50.03		7	48.21	10.82
α Cephei	W.		16	1.02	− 0.14	− 4.22	− 2.68		15	53.98		15	43.24	10.74
β Aquarii	W.	21	25	19.18	− 0.04	+ 5.50	− 1.26	21	25	23.38	21	25	12.36	− 11.02

NORMAL EQUATIONS.

$a_0 = +7^s.2 \qquad c_0 = +1^s.2 \qquad \Delta T_0 = -11^s.00 \quad \text{for } 21^h.0$

$$\begin{aligned}
&s.\\
0 &= -0.286 + 9.29\,d\,\Delta T + 2.67\,da + 2.16\,dc\\
0 &= +0.619 + 2.67\,d\,\Delta T + 4.41\,da + 3.10\,dc\\
0 &- -0.606 + 2.16\,d\,\Delta T + 3.10\,da + 20.20\,dc
\end{aligned}$$

$$\begin{aligned}
&s. && s.\\
d\,\Delta T &= +0.084 & \Delta T &= -10.916 \text{ (wt. = 7.67)}\\
da &= -0.231 & a &= +6.969 \text{ (wt. = 3.33)}\\
dc &= +0.057 & c &= +1.257 \text{ (wt. = 18.01)}
\end{aligned}$$

The Dalles, September 17, 1878.

Name of star.	Clamp.	T.			B b.	A a.	C c.	T′.			A. R.			ΔT.
		h.	*m.*	*s.*	*s.*	*s.*	*s.*	*h.*	*m.*	*s.*	*h.*	*m.*	*s.*	*s.*
δ Aquilæ	W.	19	19	28.06	+ 0.15	+ 2.30	− 0.19	19	19	30.32	19	19	24.28	− 6.04
β Cygni	W.		25	55.52	+ 0.22	+ 1.17	− 0.21		25	56.70		25	50.99	5.71
ζ Aquilæ	W.		30	26.92	+ 0.12	+ 2.72	− 0.19		30	29.57		30	23.41	6.16
γ Aquilæ	W.		40	34.80	+ 0.17	+ 1.98	− 0.19		40	36.76		40	30.96	5.80
α Aquilæ	W.		44	57.10	+ 0.16	+ 2.06	− 0.19		44	59.13		44	53.31	5.82
ε Draconis	W.		48	45.68	+ 0.55	− 4.07	− 0.54		48	41.62		48	35.95	5.67
γ Sagittæ	W.	19	53	27.32	+ 0.20	+ 1.59	− 0.20	19	53	28.91	19	53	23.15	5.76
κ Cephei	E.	20	13	11.24	+ 0.98	− 8.12	+ 0.85	20	13	4.95	20	12	58.60	6.35
ε Delphini	E.		27	30.18	+ 0.21	+ 1.96	+ 0.19		27	32.54		27	26.65	5.89
α Cygni	E.	20	37	24.44	+ 0.36	+ 0.06	+ 0.26	20	37	25.12	20	37	19.37	5.75
α Cephei	E.	21	15	49.84	+ 0.52	− 2.05	+ 0.40	21	15	48.71	21	15	42.95	5.76
β Aquarii	E.		25	15.11	+ 0.16	+ 2.67	+ 0.19		25	18.13		25	12.31	5.82
ε Pegasi	E.	21	38	18.86	+ 0.21	+ 2.03	+ 0.19	21	38	21.29	21	38	15.55	− 5.74

NORMAL EQUATIONS.

$a_0 = +3^s.5 \qquad c_0 = +0^s.2 \qquad \Delta T_0 = -5^s.8 \qquad \text{for } 20^h.0$

$$
\begin{aligned}
0 &= +\overset{s.}{1.038} + 10.36\, d\Delta T + 4.35\, da - 0.38\, dc \\
0 &= +0.739 + 4.35\, d\Delta T + 4.77\, da - 3.72\, dc \\
0 &= -0.208 - 0.38\, d\Delta T - 3.72\, da + 18.32\, dc
\end{aligned}
$$

$$
\begin{aligned}
d\Delta T &= -\overset{s.}{0.051} & \Delta T &= -\overset{s.}{5.851}\ (\text{wt.} = 5.82) \\
da &= -0.120 & a &= +3.380\ (\text{wt.} = 2.25) \\
dc &= -0.014 & c &= +0.186\ (\text{wt.} = 14.00)
\end{aligned}
$$

The Dalles, September 5, 1878; after signals.

Name of star.	Clamp.	T.			Bb.	Aa.	Cc.	T'.			A. R.			Δ T.
		h.	*m.*	*s.*	*s.*	*s.*	*s.*	*h.*	*m.*	*s.*	*h.*	*m.*	*s.*	*s.*
θ Aquilæ	E.	20	5	8.94	+ 0.02	+ 5.08	+ 1.26	20	5	15.30	20	5	4.46	− 10.84
α Capriconi	E.		11	24.84	+ 0.01	+ 6.10	+ 1.29		11	32.24		11	21.29	10.95
γ Cygni	E.		18	2.22	+ 0.03	+ 0.91	+ 1.64		17	4.80		18	54.18	10.62
ε Delphini	E.		27	32.70	+ 0.02	+ 4.04	+ 1.28		27	38.04		27	26.77	11.27
Gr. 3241	E.		30	51.08	+ 0.07	−10.14	+ 4.10		30	45.11		30	33.80	11.31
α Cygni	E.		37	28.40	+ 0.03	+ 0.13	+ 1.77		37	30.33		37	19.58	10.75
ε Cygni	E.		41	27.52	+ 0.03	+ 1.75	+ 1.51		41	30.81		41	19.92	10.89
Bradley 2749	W.	20	53	48.24	− 0.33	−22.94	− 7.31	20	53	17.66	20	53	6.46	11.20
61 Cygni pr.	W.	21	1	40.90	− 0.09	+ 1.15	− 1.60	21	1	40.36	21	1	29.36	11.00
ζ Cygni	W.		7	58.36	− 0.08	+ 2.19	− 1.44		7	59.03		7	48.21	10.82
α Cephei	W.		16	1.02	− 0.14	− 4.22	− 2.68		15	53.98		15	43.24	10.74
β Aquarii	W.	21	25	19.18	− 0.04	+ 5.50	− 1.26	21	25	23.38	21	25	12.36	− 11.02

NORMAL EQUATIONS.

$$a_0 = + 7^s.2 \qquad c_0 = + 1^s.2 \qquad \Delta T_0 = - 11^s.00 \qquad \text{for } 21^h.0$$

$$\begin{aligned} &\quad\;\; s. \\ 0 &= - 0.286 + 9.29\, d\Delta T + 2.67\, da + 2.16\, dc \\ 0 &= + 0.619 + 2.67\, d\Delta T + 4.41\, da + 3.10\, dc \\ 0 &- - 0.606 + 2.16\, d\Delta T + 3.10\, da + 20.20\, dc \end{aligned}$$

$$\begin{aligned} &\qquad s. & &\qquad s. \\ d\Delta T &= + 0.084 & \Delta T &= - 10.916 \text{ (wt. = 7.67)} \\ da &= - 0.231 & a &= + 6.969 \text{ (wt. = 3.33)} \\ dc &= + 0.057 & c &= + 1.257 \text{ (wt. = 18.01)} \end{aligned}$$

The Dalles, September 17, 1878.

Name of star.	Clamp.	T.			B *b*.	A *a*.	C *c*.	T′.			A. R.			ΔT.
		h.	*m.*	*s.*	*s.*	*s.*	*s.*	*h.*	*m.*	*s.*	*h.*	*m.*	*s.*	*s.*
δ Aquilæ	W.	19	19	28.06	+ 0.15	+ 2.30	— 0.19	19	19	30.32	19	19	24.28	— 6.04
β Cygni	W.		25	55.52	+ 0.22	+ 1.17	— 0.21		25	56.70		25	50.99	5.71
κ Aquilæ	W.		30	26.92	+ 0.12	+ 2.72	— 0.19		30	29.57		30	23.41	6.16
γ Aquilæ	W.		40	34.80	+ 0.17	+ 1.98	— 0.19		40	36.76		40	30.96	5.80
α Aquilæ	W.		44	57.10	+ 0.16	+ 2.06	— 0.19		44	59.13		44	53.31	5.82
ε Draconis	W.		48	45.68	+ 0.55	— 4.07	— 0.54		48	41.62		48	35.95	5.67
γ Sagittæ	W.	19	53	27.32	+ 0.20	+ 1.59	— 0.20	19	53	28.91	19	53	23.15	5.76
κ Cephei	E.	20	13	11.24	+ 0.98	— 8.12	+ 0.85	20	13	4.95	20	12	58.60	6.35
ε Delphini	E.		27	30.18	+ 0.21	+ 1.96	+ 0.19		27	32.54		27	26.65	5.89
α Cygni	E.	20	37	24.44	+ 0.36	+ 0.06	+ 0.26	20	37	25.12	20	37	19.37	5.75
α Cephei	E.	21	15	49.84	+ 0.52	— 2.05	+ 0.40	21	15	48.71	21	15	42.95	5.76
β Aquarii	E.		25	15.11	+ 0.16	+ 2.67	+ 0.19		25	18.13		25	12.31	5.82
ε Pegasi	E.	21	38	18.86	+ 0.21	+ 2.03	+ 0.19	21	38	21.29	21	38	15.55	— 5.74

NORMAL EQUATIONS.

$a_0 = +3^{s}.5 \qquad c_0 = +0^{s}.2 \qquad \Delta T_0 = -5^{s}.8 \qquad \text{for } 20^{h}.0$

$$
\begin{aligned}
&\ \text{s.}\\
0 &= +1.038 + 10.36\, d\Delta T + 4.35\, da - 0.38\, dc\\
0 &= +0.739 + 4.35\, d\Delta T + 4.77\, da - 3.72\, dc\\
0 &= -0.208 - 0.38\, d\Delta T - 3.72\, da + 18.32\, dc
\end{aligned}
$$

$$
\begin{aligned}
&\ \text{s.} && \ \text{s.}\\
d\Delta T &= -0.051 & \Delta T &= -5.851 \text{ (wt.} = 5.82)\\
da &= -0.120 & a &= +3.380 \text{ (wt.} = 2.25)\\
dc &= -0.014 & c &= +0.186 \text{ (wt.} = 14.00)
\end{aligned}
$$

The Dalles, September 20, 1878; before signals.

Name of star.	Clamp.	T.			B *b*.	A *a*.	C *c*.	T′.			A. R.			Δ T.
		h.	*m.*	*s.*	*s.*	*s.*	*s.*	*h.*	*m.*	*s.*	*h.*	*m.*	*s.*	*s.*
χ Draconis	E.	18	23	26.38	− 0.16	− 5.47	+ 0.77	18	23	21.52	18	23	14.67	− 6.85
3 H. Scuti	E.		28	41.16	− 0.03	+ 2.92	+ 0.23		28	44.28		28	37.50	− 6.78
α Lyræ	E.		32	56.60	− 0.07	+ 0.55	+ 0.29		32	57.37		32	50.71	− 6.66
110 Herculis	E.		40	32.50	− 0.05	+ 1.62	+ 0.24		40	34.31		40	27.47	− 6.84
β Lyræ	E.		45	42.84	− 0.06	+ 0.92	+ 0.27		45	43.97		45	37.02	− 6.95
σ Sagittarii	E.		47	48.90	− 0.02	+ 3.80	+ 0.26		47	52.94		47	46.03	− 6.91
γ Lyræ	W.		54	31.60	− 0.20	+ 0.96	− 0.27		54	32.09		54	25.33	− 6.76
ζ Aquilæ	W.	18	59	56.50	− 0.15	+ 1.94	− 0.24	18	59	58.05	18	59	51.21	− 6.84
δ Draconis	W.	19	12	43.42	− 0.42	− 3.47	− 0.60	19	12	38.93	19	12	32.20	− 6.73
δ Aquilæ	W.		19	28.90	− 0.13	+ 2.43	− 0.23		19	30.97		19	24.23	− 6.74
β Cygni	W.		25	56.92	− 0.19	+ 1.24	− 0.26		25	57.71		25	50.94	− 6.77
κ Aquilæ	W.		30	27.66	− 0.11	+ 2.87	− 0.23		30	30.19		30	23.36	− 6.83
γ Aquilæ	W.		40	36.14	− 0.14	+ 2.10	− 0.23		40	37.87		40	30.91	− 6.96
ε Draconis	W.	19	48	48.16	− 0.46	− 4.30	− 0.67	19	48	42.73	19	48	35.77	− 6.96

NORMAL EQUATIONS.

$a_0 = +3^s.5 \qquad c_0 = +0^s.2 \qquad \Delta T_0 = -6^s.80 \qquad \text{for } 19^h.0$

$$
\begin{aligned}
&\overset{s.}{}\\
0 &= +0.039 + 11.14\, d\,\Delta T + 4.11\, da - 1.16\, dc\\
0 &= -0.278 + 4.11\, d\,\Delta T + 5.21\, da + 0.28\, dc\\
0 &= -0.670 - 1.16\, d\,\Delta T + 0.28\, da + 21.42\, dc
\end{aligned}
$$

$$
\begin{aligned}
&\quad\ \ s. &&\quad\ \ s.\\
d\,\Delta T &= -0.028 & \Delta T &= -6.828\ (\text{wt.} = 7.81)\\
da &= +0.074 & a &= +3.574\ (\text{wt.} = 3.67)\\
dc &= +0.029 & c &= +0.229\ (\text{wt.} = 21.16)
\end{aligned}
$$

The Dalles, September 20, 1878; after signals.

Name of star.	Clamp.	T.	B*b*.	A*a*.	C*c*.	T′.	A. R.	ΔT.
		h. m. s.	*s.*	*s.*	*s.*	*h. m. s.*	*h. m. s.*	*s.*
ζ Cygni	W.	21 7 54.14	− 0.28	+ 1.18	− 0.24	21 7 54.80	21 7 48.07	− 6.73
α Cephei	W.	15 52.90	− 0.51	− 2.26	− 0.45	15 49.68	15 42.87	6.81
β Aquarii	W.	25 16.66	− 0.16	+ 2.95	− 0.21	25 19.24	25 12.29	6.95
ξ Aquarii	W.	31 23.76	− 0.15	+ 3.06	− 0.21	31 26.46	31 19.63	6.83
11 Cephei	E.	40 22.20	− 0.39	− 4.82	+ 0.63	40 17.62	40 10.76	6.86
μ Capricorni	E.	46 46.22	− 0.07	+ 3.33	+ 0.22	46 49.70	46 43.00	6.70
α Aquarii	E.	21 59 39.24	− 0.10	+ 2.71	+ 0.21	21 59 42.06	21 59 35.16	− 6.90

NORMAL EQUATIONS.

$a_0 = +3^s.5 \qquad c_0 = +0^s.2 \qquad \Delta T_0 = -6^s.8 \qquad$ for $21^h.5$

$$
\begin{aligned}
&\overset{s.}{}\\
0 &= -0.500 + 5.81\,d\Delta T + 2.72\,da - 1.18\,dc\\
0 &= -0.749 + 2.72\,d\Delta T + 3.46\,da - 0.97\,dc\\
0 &= +0.105 - 1.18\,d\Delta T - 0.97\,da + 10.99\,dc
\end{aligned}
$$

$$
\begin{aligned}
d\wedge T &= \overset{s.}{-0.023} & \Delta T &= \overset{s.}{-6.823}\ (\text{wt.} = 3.65)\\
da &= +0.237 & a &= +3.737\ (\text{wt.} = 2.17)\\
dc &= +0.009 & c &= +0.209\ (\text{wt.} = 10.67)
\end{aligned}
$$

The Dalles, September 21, 1878.

Name of star.	Clamp.	T.			B*b*.	A*a*.	C*c*.	T′.			A.R.			ΔT.
		h.	*m.*	*s.*	*s.*	*s.*	*s.*	*h.*	*m.*	*s.*	*h.*	*m.*	*s.*	*s.*
δ Aquilæ	E.	19	19	32.74	− 0.02	− 2.09	+ 0.24	19	19	30.87	19	19	24.22	− 6.65
β Cygni	E.		25	58.14	− 0.03	− 1.07	+ 0.27		25	57.31		25	50.92	− 6.39
κ Aquilæ	E.		30	32.18	− 0.02	− 2.48	+ 0.24		30	29.92		30	23.42	− 6.50
γ Aquilæ	E.		40	39.24	− 0.02	− 1.81	+ 0.24		40	37.65		40	30.90	− 6.75
ε Draconis	E.		48	38.80	− 0.07	+ 3.70	+ 0.69		48	43.12		48	35.71	− 7.41
γ Sagittæ	W.		53	31.54	+ 0.03	− 1.45	− 0.25		53	29.87		53	23.09	− 6.78
τ Aquilæ	W.	19	58	23.22	+ 0.02	− 1.94	− 0.24	19	58	21.06	19	58	14.33	− 6.73
θ Aquilæ	W.	20	5	13.66	+ 0.02	− 2.24	− 0.24	20	5	11.20	20	5	4.27	− 6.93
ζ Cygni	W.	21	7	55.86	+ 0.01	− 0.97	− 0.27	21	7	54.63	21	7	48.05	− 6.58
α Cephei	W.		15	47.88	+ 0.02	+ 1.86	− 0.50		15	49.26		15	42.84	− 6.42
β Aquarii	W.		25	21.46	0.00	− 2.43	− 0.24		25	18.79		25	12.28	− 6.51
ξ Aquarii	W.		31	28.62	0.00	− 2.52	− 0.24		31	26.16		31	10.62	− 6.54
11 Cephei	E.		40	11.96	+ 0.35	+ 3.97	+ 0.72		40	17.00		40	10.72	− 6.28
79 Draconis	E.	21	51	24.28	+ 0.38	+ 4.90	+ 0.81	21	51	30.37	21	51	24.00	− 6.37

NORMAL EQUATIONS.

$a_0 = -3^{s}.0 \qquad c_0 = +0^{s}.2 \qquad \Delta T_0 = -6^{s}.7 \qquad \text{for } 20^{h}.5$

$$\begin{aligned} & \;\;\;\; s. \\ 0 &= -0.309 + 11.26\, d\,\Delta T + 4.61\, da - 0.50\, dc \\ 0 &= +0.321 + 4.61\, d\,\Delta T + 5.81\, da - 4.21\, dc \\ 0 &= -1.059 - 0.50\, d\,\Delta T - 4.21\, da + 21.44\, dc \end{aligned}$$

$$\begin{aligned} &\;\;\;\;\;\;\; s. & &\;\;\;\;\;\;\; s. \\ d\,\Delta T &= +0.061 & \Delta T &= -6.639 \; (\text{wt.} = 7.17) \\ da &= -0.078 & a &= -3.078 \; (\text{wt.} = 3.17) \\ dc &= +0.036 & c &= +0.276 \; (\text{wt.} = 17.33) \end{aligned}$$

The Dalles, September 22, 1878.

Name of star.	Clamp.	T.			Bb.	Aa.	Co.	T'.			A.R.			ΔT.
		h.	*m.*	*s.*	*s.*	*s.*	*s.*	*h.*	*m.*	*s.*	*h.*	*m.*	*s.*	*s.*
109 Herculis	E.	18	18	39.22	+ 0.06	− 0.82	+ 0.37	18	18	38.83	18	18	32.57	− 6.26
χ Draconis	E.		25	16.76	+ 0.18	+ 2.86	+ 1.17		25	20.97		23	14.50	6.47
α Lyræ	E.		33	56.56	+ 0.08	− 0.29	+ 0.44		33	56.79		32	50.65	6.14
110 Herculis	E.		40	34,26	+ 0.06	− 0.85	+ 0.37		40	33.84		40	27.43	6.41
β Lyræ	E.		45	43.24	+ 0.07	− 0.48	+ 0.42		45	43.25		45	36.86	6.39
σ Sagittarii	E.		47	53.87	+ 0.02	− 1.99	+ 0.39		47	52.29		47	46.00	6.29
γ Lyræ	E.		54	31.46	+ 0.07	− 0.50	+ 0.41		54	31.44		54	25.28	6.16
ζ Aquilæs	W.	18	59	58.70	+ 0.08	− 1.02	− 0.36	18	59	57.40	18	59	51.18	6.22
δ Draconi	W.	19	12	37.00	+ 0.23	+ 1.82	− 0.90	19	12	38.15	19	12	32.09	6.06
δ Aquilæ	W.		19	32.08	+ 0.07	− 1.27	− 0.35		19	30.53		19	24.20	6.33
β Cygni	W.		25	58.14	+ 0.10	− 0.65	− 0.39		25	57.20		25	50.90	6.30
κ Aquilæ	W.		30	31.42	+ 0.06	− 1.50	− 0.35		30	29.63		30	23.33	6.30
γ Aquilæ	W.		40	38.70	+ 0.08	− 1.10	− 0.35		40	37.33		40	30.88	6.45
ε Draconis	W.	19	48	40.64	+ 0.25	+ 2.25	− 1.01	19	48	42.13	19	48	35.65	− 6.48

NORMAL EQUATIONS.

$a_0 = -1^s.8 \qquad c_0 = +0^s.2 \qquad \Delta T_0 = -6^s.3 \qquad \text{for } 19^h.0$

$$\begin{aligned} & \;\; s. \\ 0 &= +0.295 + 11.40\, d\Delta T + 3.91\, da - 0.07\, dc \\ 0 &= +0.287 + 3.91\, d\Delta T + 4.84\, da + 0.40\, dc \\ 0 &= -3.192 - 0.07\, d\Delta T + 0.40\, da + 21.84\, dc \end{aligned}$$

$$\begin{aligned} & \qquad\qquad s. & & \qquad\quad s. \\ d\Delta T &= -0.001 & \Delta T &= -6.301 \; (\text{wt.} = 8.24) \\ da &= -0.071 & a &= -1.871 \; (\text{wt.} = 3.49) \\ dc &= +0.147 & c &= +0.347 \; (\text{wt.} = 21.79) \end{aligned}$$

Ogden, September 5, 1878; before signals.

Name of star.	Clamp.	T.	Bb.	a.	Cc.	T'.	A. R.	ΔT.
		h. m. s.	s.	s.	s.	h. m. s.	h. m. s.	m. s.
o Herculis	E.	18 5 40.05	+ 0.01	+ 0.08	+ 0.18	18 5 40.32	18 2 49.67	− 2 50.65
A Herculis	E.	18 10 11.72	+ 0.01	+ 0.07	+ 0.19	10 11.90	18 7 21.38	2 50.61
204 Heis Herculis	E.	18 15 39.42	+ 0.01	+ 0.14	+ 0.17	15 39.74	18 12 49.05	2 50.69
χ Draconis	E.	18 26 6.44	+ 0.02	− 0.60	+ 0.53	26 6.39	18 23 15.65	2 50.74
9 Heis Lyræ	E.	18 31 3.36	+ 0.01	+ 0.07	+ 0.18	31 3.62	18 28 12.77	2 50.85
11 Heis Lyræ	E.	18 35 2.03	+ 0.01	+ 0.06	+ 0.19	35 2.29	18 32 11.47	2 50.82
Gr. 2655	E.	18 38 29.16	+ 0.03	− 0.94	+ 0.73	38 28.98	18 35 37.58	2 51.40
γ Lyræ	W.	18 57 16.50	− 0.05	+ 0.06	− 0.19	18 57 16.32	18 54 25.68	2 50.64
16 Lyræ	W.	19 0 53.16	− 0.06	− 0.05	− 0.23	19 0 52.82	18 58 1.66	2 51.16
25 H. Camelop. S P	W.	19 8 13.99	+ 0.18	+ 2.22	+ 1.23	8 17.62	7 5 25.86	2 51.76
θ Lyræ	W.	19 15 1.74	− 0.05	+ 0.03	− 0.20	15 1.52	19 12 10.79	2 50.73
τ Draconis	W.	19 20 46.55	− 0.12	− 0.62	− 0.54	20 45.27	19 17 54.40	2 50.87
4 Cygni	W.	19 24 39.57	− 0.05	+ 0.04	− 0.20	24 39.36	19 21 48.37	2 50.99
β Cygni	W.	19 28 42.22	− 0.05	+ 0.09	− 0.18	19 28 42.08	19 25 51.20	− 2 50.88

NORMAL EQUATIONS.

$a_0 = +0^s.40 \qquad c_0 = +0^s.15 \qquad \Delta T_0 = -2^m.50^s.83 \text{ for } 19^h.0$

$$\begin{aligned} & {}^{s.} \\ 0 &= -0.169 + 9.907\, d\Delta T + 0.547\, da + 1.169\, dc \\ 0 &= +0.341 + 0.547\, d\Delta T + 6.426\, da + 2.045\, dc \\ 0 &= -0.121 + 1.169\, d\Delta T + 2.045\, da + 27.698\, dc \end{aligned}$$

$$\begin{aligned} d\Delta T &= +0.019^{s} & \Delta T &= -2^{m}\ 50^{s}.811 \ (\text{wt.} = 9.82) \\ da &= -0.057 & a &= +\ 0.343 \ (\text{wt.} = 6.25) \\ dc &= +0.008 & c &= +\ 0.158 \ (\text{wt.} = 26.95) \end{aligned}$$

Ogden, September 5, 1878; after signals.

Name of star.	Clamp.	T.			Bb.	Aa.	Cc.	T′.			A. R.			ΔT.	
		h.	*m.*	*s.*	*s.*	*s.*	*s.*	*h.*	*m.*	*s.*	*h.*	*m.*	*s.*	*m.*	*s.*
73 Draconis	W.	20	36	0.94	− 0.19	− 0.91	− 0.59	20	35	59.25	20	33	8.09	− 2	51.16
α Cygni	W.	20	40	11.40	− 0.09	− 0.04	− 0.21		40	11.06	20	37	19.52	2	51.54
ε Cygni	W.	20	44	11.25	− 0.07	+ 0.07	− 0.18		44	11.07	20	41	19.90	2	51.17
32 Vulpeculæ	W.	20	52	16.43	− 0.07	+ 0.12	− 0.17		52	16.31	20	49	25.17	2	51.14
Brdl. 2749	W.	20	56	0.05	− 0.28	− 1.47	− 0.88	20	55	57.42	20	53	6.38	2	51.04
Pi. XXI, 1	E.	21	6	22.77	+ 0.03	+ 0.10	+ 0.17	21	6	23.07	21	3	31.96	2	51.11
77 Draconis	E.	21	10	48.94	+ 0.10	− 1.23	+ 0.71		10	48.52	21	7	57.21	2	51.31
1 Pegasi	E.	21	19	21.23	+ 0.03	+ 0.17	+ 0.16		19	21.59	21	16	30.36	2	51.23
Pi. XXI, 120	E.	21	22	3.53	+ 0.03	+ 0.13	+ 0.17		22	3.86	21	19	12.57	2	51.29
70 Cygni	E.	21	25	17.28	+ 0.03	+ 0.04	+ 0.19		25	17.54	21	22	26.46	2	51.08
Gr. 3511	E.	21	31	17.04	+ 0.12	− 1.59	+ 0.87	21	31	16.44	21	28	25.00	− 2	51.44

NORMAL EQUATIONS.

$a_0 = +0^s.40 \qquad c_0 = +0^s.15 \qquad \Delta T_0 = -2^m.\ 51^s.23 \quad \text{for } 21^h.0$

$$\begin{aligned} & \quad\ \ s. \\ 0 &= -0.068 + 7.058\, d\,\Delta T - 0.550\, da + 0.836\, dc \\ 0 &= -0.241 - 0.550\, d\,\Delta T + 5.883\, da + 0.428\, dc \\ 0 &= -0.044 + 0.836\, d\,\Delta T + 0.428\, da + 24.137\, dc \end{aligned}$$

$$\begin{aligned} & \quad\ s. & & \quad m.\ \ s. \\ d\,\Delta T &= +0.013 & \Delta T &= -2\ 51.217\ (\text{wt.} = 6.98) \\ da &= +0.042 & a &= +\ \ 0.442\ (\text{wt.} = 5.83) \\ dc &= +0.001 & c &= +\ \ 0.151\ (\text{wt.} = 24.00) \end{aligned}$$

Ogden, September 17, 1878.

Name of star.	Clamp.	T.	Bb.	A a.	C c.	T′.	A. R.	ΔT.
		h. m. s.	s.	s.	s.	h. m. s.	h. m. s.	m. s.
α Cygni	E.	20 40 9.95	− 0.08	− 0.04	+ 0.24	20 40 10.07	20 37 19.31	− 2 50.76
ε Cygni	E.	20 44 9.08	− 0.07	+ 0.07	+ 0.20	20 44 9.28	20 41 19.76	2 50.42
α Cephei	E.	21 18 33.59	− 0.12	− 0.35	+ 0.37	21 18 33.49	21 15 42.94	2 50.55
ε Pegasi	E.	21 41 5.77	− 0.05	+ 0.25	+ 0.17	21 41 6.14	21 38 15.51	− 2 50.63

NORMAL EQUATIONS.

$\rho_0 = +\,0^s.37 \qquad c_0 = +\,0^s.17$ (assumed correct.) $\qquad \Delta T_0 = -\,2^m\ 50^s.56$ for $21^h.0$

$$0 = +\,\overset{s.}{0.087} + 3.26\,d\,\Delta T + 0.18\,da$$
$$0 = -\,0.050 + 0.18\,d\,\Delta T + 0.64\,da$$

$$d\,\Delta T = -\,\overset{s.}{0.081} \qquad \Delta T = -\,\overset{m.}{2}\ \ \overset{s.}{50.591}\ (\text{wt.} = 3.21)$$
$$da = +\,0.09 \qquad a = +\ \ 0.46\ (\text{wt.} = 0.63)$$

A night mainly cloudy, with a few clear patches. The value of ρ was taken from observations on neighboring dates, and is quite certain.

	Clamp.	T.			Bb.	Aa.	Cc.								
		h.	m.	s.	s.	s.	s.	h.	m.	s.	h.	m.	s.	m.	s.
κ Lyræ	W.	18	18	23.65	0.00	+ 0.02	− 0.27	18	18	23.40	18	15	37.38	− 2	46.02
109 Herculis	W.		21	18.93	0.00	+ 0.06	− 0.23		21	18.76	18	18	32.58	2	46.18
χ Draconis	W.		26	1.59	0.01	− 0.28	− 0.72		26	0.58	18	23	14.50	2	46.08
9 Heis Lyræ	W.		30	58.81	0.00	+ 0.03	− 0.25		30	58.59	18	28	12.47	2	46.12
α Lyræ	W.		35	36.98	0.00	+ 0.01	− 0.28		35	36.71	18	32	50.69	2	46.02
γ Lyræ	E.	18	57	11.10	+ 0.01	+ 0.03	+ 0.25	18	57	11.39	18	54	25.37	2	46.02
ζ Aquilæ	E.	19	2	37.03	+ 0.01	+ 0.08	+ 0.22	19	2	37.34	18	59	51.21	2	46.13
ι Lyræ	E.		5	45.11	+ 0.02	+ 0.02	+ 0.27		5	45.42	19	2	59.39	2	46.03
19 Lyræ	E.		9	53.60	+ 0.01	+ 0.03	+ 0.25		9	53.89	19	7	7.91	2	45.98
δ Draconis	E.		15	17.85	+ 0.03	− 0.19	+ 0.56		15	18.25	19	12	32.18	2	46.07
τ Draconis	E.	19	20	39.03	+ 0.04	− 0.30	+ 0.74	19	20	39.51	19	17	53.32	− 2	46.19

NORMAL EQUATIONS.

$a_0 = +0^s.20 \qquad c_0 = +0^s.23 \qquad \Delta T_0 = -2^m\ 46^s.07$ for $19^h.0$

$$\begin{aligned} &\text{s.} \\ 0 &= +0.007 + 8.37\, d\Delta T + 0.09\, da + 1.04\, dc \\ 0 &= +0.095 + 0.09\, d\Delta T + 2.90\, da - 1.09\, dc \\ 0 &= +0.246 + 1.04\, d\Delta T - 1.09\, da + 19.76\, dc \end{aligned}$$

$$\begin{array}{rl} & \text{s.} \\ d\Delta T = & +0.001 \\ da = & -0.038 \\ dc = & -0.015 \end{array} \qquad \begin{array}{rrl} & \text{m.} & \text{s.} \\ \Delta T = & -\ 2 & 46.069\ (\text{wt.} = 8.31) \\ a = & + & 0.162\ (\text{wt.} = 2.84) \\ c = & + & 0.215\ (\text{wt.} = 19.21) \end{array}$$

Ogden, September 20, 1878; after signals.

Name of star.	Clamp.	T.	B*b*.	A*a*.	C*c*.	T.	A. R.	ΔT.
		h. m. s.	*s.*	*s.*	*s.*	*h. m. s.*	*h. m. s.*	*m. s.*
11 Cephei	E.	21 42 56.01	+ 0.06	− 0.33	+ 0.77	21 42 56.51	21 40 10.79	− 2 45.72
16 Pegasi	E.	50 19.82	+ 0.02	+ 0.07	+ 0.28	50 20.19	21 47 34.87	2 45.82
17 Pegasi	E.	53 48.96	+ 0.02	+ 0.11	+ 0.26	53 49.35	21 51 3.37	2 45.98
20 Pegasi	E.	21 57 58.20	+ 0.02	+ 0.11	+ 0.26	21 57 58.59	21 55 12.64	2 45.95
27 Pegasi	E.	22 6 38.61	+ 0.02	+ 0.04	+ 0.30	22 6 38.97	22 3 53.00	2 45.97
24 Cephei	E.	10 16.42	+ 0.06	− 0.35	+ 0.81	10 16.94	22 7 31.00	2 45.94
38 Pegasi	W.	27 16.99	0.00	+ 0.04	− 0.30	27 16.73	22 24 30.83	2 45.90
Gr. 3804	W.	29 52.85	0.00	+ 0.01	− 0.33	29 52.53	22 27 6.60	2 45.93
31 Cephei	W.	35 36.58	+ 0.01	− 0.40	− 0.87	35 35.32	22 32 49.29	2 46.03
η Pegasi	W.	40 6.98	0.00	+ 0.05	− 0.29	40 6.74	22 37 20.96	2 45.78
λ Pegasi	W.	22 43 29.28	0.00	+ 0.07	− 0.28	22 43 29.07	22 40 43.24	− 2 45.83

NORMAL EQUATIONS.

$$a_0 = +\,0^s.20 \qquad c_0 = +\,0^s.23 \qquad \Delta T^0 = -\,2^m\ 45^s.90 \qquad \text{for } 22^h.0$$

$$\begin{aligned}
&\quad\ \ {}^{s.}\\
0 &= -\,0.053 + 8.48\,d\,\Delta T + 0.64\,da + 0.92\,dc\\
0 &= -\,0.045 + 0.64\,d\,\Delta T + 3.34\,da - 0.80\,dc\\
0 &= -\,0.464 + 0.92\,d\,\Delta T - 0.80\,da + 19.41\,dc
\end{aligned}$$

$$\begin{aligned}
& \qquad\quad {}^{s.} && \qquad\qquad {}^{m.\ \ s.}\\
d\,\Delta T &= +\,0.002 & \Delta T &= -\,2\ \ 45.898\ (\text{wt.} = 8.30)\\
da &= +\,0.019 & a &= +\,0\ \ \ 0.219\ (\text{wt.} = 3.25)\\
dc &= +\,0.025 & c &= +\,0\ \ \ 0.255\ (\text{wt.} = 19.08)
\end{aligned}$$

Ogden, September 21, 1878; before signals.

Name of star.	Clamp.	T.			B b.	Ȧ a.	C c.	T′.			A. R.			Δ T.	
		h.	*m.*	*s.*	*s.*	*s.*	*s.*	*h.*	*m.*	*s.*	*h.*	*m.*	*s.*	*m.*	*s.*
χ Draconis	W.	18	25	59.95	− 0.09	− 0.37	− 0.52	18	25	58.97	18	23	14.59	− 2	44.38
α Lyræ	W.		35	35.00	− 0.04	+ 0.01	− 0.20		35	34.77	18	32	50.66	2	44.11
β Lyræ	W.		48	21.16	− 0.04	+ 0.03	− 0.19		48	20.96	18	45	36.92	2	44.04
δ² Lyræ	W.		53	0.96	− 0.04	+ 0.02	− 0.19		83	0.75	18	50	16.55	2	44.20
γ Lyræ	W.	18	57	9.63	− 0.04	+ 0.04	− 0.18	18	57	9.45	18	54	25.35	2	44.10
τ Draconis	E.	19	20	37.22	− 0.04	− 0.38	+ 0.53	19	20	37.33	19	17	53.24	2	44.09
4 Cygni	E.		24	31.94	− 0.01	+ 0.02	+ 0.19		24	32.14	19	21	48.03	2	44.11
β Cygni	E.		28	34.90	− 0.01	+ 0.06	+ 0.17		28	35.12	19	25	50.92	2	44.20
9 Cygni	E.		32	46.77	− 0.01	+ 0.05	+ 0.18		32	46.99	19	30	2.79	2	44.20
φ Cygni	E.		37	20.31	− 0.01	+ 0.05	+ 0.18		37	20.53	19	34	36.22	2	44.31
28 Heis Cygni	E.		40	49.59	− 0.01	+ 0.04	+ 0.18		40	49.80					
ε Draconis	E.	19	51	19.58	− 0.03	− 0.29	+ 0.45	19	51	19.71	19	48	35.67	− 2	44.04

NORMAL EQUATIONS.

$a_0 = +0^s.25$ $c_0 = +0^s.18$ $\Delta T_0 = -2^m\ 44^s.16$ for $19^h.0$

$$
\begin{aligned}
&\overset{s.}{0 = +0.024} + 8.24\, d\Delta T - 0.29\, da + 0.94\, dc \\
&0 = +0.088 - 0.29\, d\Delta T + 2.83\, da - 1.15\, dc \\
&0 = +0.466 + 0.94\, d\Delta T - 1.15\, da + 20.24\, dc
\end{aligned}
$$

$$
\begin{aligned}
d\Delta T &= -\overset{s.}{0.002} & \Delta T &= -\overset{m.\ s.}{2\ 44.162}\ (\text{wt.} = 8.18) \\
da &= -0.041 & a &= +\ 0.209\ (\text{wt.} = 2.75) \\
dc &= -0.025 & c &= +\ 0.155\ (\text{wt.} = 19.68)
\end{aligned}
$$

Ogden, September 21, 1878; after signals.

Name of star.	Clamp.	T.			B*b*.	A*a*.	C*c*.	T′.			A. R.			T.	
		h.	*m.*	*s.*	*s.*	*s.*	*s.*	*h.*	*m.*	*s.*	*h.*	*m.*	*s.*	*m.*	*s.*
11 Cephei	E.	21	42	54.42	+ 0.09	− 0.38	+ 0.58	21	42	54.71	21	40	10.75	− 2	43.96
16 Pegasi	E.		50	18.15	+ 0.04	+ 0.08	+ 0.21		50	18.48	21	47	34.36	2	44.12
17 Pegasi	E.		53	47.00	+ 0.03	+ 0.13	+ 0.20		53	47.36	21	51	3.37	2	43.99
20 Pegasi	E.	21	57	56.37	+ 0.03	+ 0.12	+ 0.20		57	56.72	21	55	12.63	2	44.09
27 Pegasi	E.	22	6	36.68	+ 0.04	+ 0.05	+ 0.23	21	6	37.00	22	3	52.99	2	44.01
24 Cephei	E.		10	14.74	+ 0.10	− 0.41	+ 0.61	22	10	15.04	22	7	30.97	2	44.07
38 Pegasi	W.		27	14.97	− 0.02	+ 0.05	− 0.23		27	14.77	22	24	30.82	2	43.95
Gr. 3804	W.		29	50.94	− 0.02	+ 0.01	− 0.25		29	50.68	22	27	6.59	2	44.09
31 Cephei	W.		35	34.51	− 0.04	− 0.46	− 0.66		35	33.35	22	32	49.27	2	44.08
η Pegasi	W.		45	5.09	− 0.02	+ 0.06	− 0.22		40	4.91	22	37	20.96	2	43.95
λ Pegasi	W.	22	43	27.48	− 0.02	+ 0.09	− 0.21	22	43	27.34	22	40	43.23	− 2	44.11

NORMAL EQUATIONS.

$a_0 = +\,0^s.25 \qquad c_0 = +\,0^s.20 \qquad \Delta T_0 = -\,2^m\ 44^s.00 \text{ for } 22^h.0$

$$
\begin{aligned}
&\quad\ \ s. \\
0 &= +\,0.319 + 8.48\, d\Delta T + 0.64\, da + \ \ 0.92\, dc \\
0 &= +\,0.004 + 0.64\, d\Delta T + 3.35\, da - \ \ 0.80\, dc \\
0 &= +\,0.196 + 0.92\, d\Delta T - 0.80\, da + 19.41\, dc
\end{aligned}
$$

$$
\begin{array}{llll}
 & \quad s. & & m.\quad s. \\
d\Delta T & = -\,0.038 & \Delta T = -\,2 & 44.038\ (\text{wt.} = \ \ 8.30) \\
da & = +\,0.004 & a = + & \quad 0.254\ (\text{wt.} = \ \ 3.26) \\
d & = \quad 0.008 & c = + & \quad 0.192\ (\text{wt.} = 19.08)
\end{array}
$$

Ogden, September 22, 1878; before signals.

Name of star.	Clamp.	T.			B*b*.	A*a*.	C*c*.	T′.			A.R.			ΔT.	
		h.	*m.*	*s.*	*s.*	*s.*	*s.*	*h.*	*m.*	*s.*	*h.*	*m.*	*s.*	*m.*	*s.*
κ Lyræ	W.	18	18	19.92	+ 0.14	+ 0.03	− 0.27	18	18	19.82	18	15	37.33	− 2	42.49
109 Herculis	W.		21	15.31	+ 0.10	+ 0.09	− 0.28		21	15.27	18	18	32.54	2	42.73
χ Draconis	W.		25	57.70	+ 0.26	− 0.45	− 0.72		25	56.79	18	23	14.39	2	42.40
9 Heis Lyræ	W.		30	55.16	+ 0.08	+ 0.06	− 0.25		30	55.05	18	28	12.42	2	42.63
α Lyræ	W.		35	33.30	+ 0.08	+ 0.01	− 0.28		35	33.11	18	32	50.64	2	42.47
γ Lyræ	E.	18	57	7.31	+ 0.05	+ 0.05	+ 0.25	18	57	7.66	18	54	25.32	2	42.34
ζ Aquilæ	E.	19	2	33.37	+ 0.04	+ 0.12	+ 0.22	19	2	33.75	18	59	51.18	2	42.57
ι Lyræ	E.		5	41.47	+ 0.05	+ 0.03	+ 0.27		5	41.82	19	2	59.34	2	42.48
19 Lyræ	E.		9	50.10	+ 0.05	+ 0.05	+ 0.25		9	50.45	19	7	7.87	2	42.58
δ Draconis	E.		15	14.15	+ 0.10	− 0.29	+ 0.56		15	14.52	19	12	32.06	2	42.46
τ Draconis	E.	19	20	35.65	+ 0.13	− 0.47	+ 0.74	19	20	36.05	19	17	53.17	− 2	42.88

NORMAL EQUATIONS.

$a_0 + 0^s.30 \qquad c_0 = + 0^s.20 \qquad \Delta T_0 = - 2^m\, 42^s.54 \text{ for } 19^h.0$

$$
\begin{aligned}
& \overset{s.}{} \\
0 &= - 0.005 + 8.38\, d\, \Delta\, T + 0.09\, da + 1.05\, dc \\
0 &= + 0.144 + 0.09\, d\, \Delta\, T + 2.89\, da - 1.08\, dc \\
0 &= - 0.337 + 1.05\, d\, \Delta\, T - 1.08\, da + 19.76\, dc
\end{aligned}
$$

$$
\begin{aligned}
& \overset{s.}{} & & \overset{m.\quad s.}{} \\
d\, \Delta\, T\, \Delta &- 0.001 & \Delta\, T &= - 2\ 42.541\ (\text{wt.} = 8.31) \\
da\, \Delta &- 0.044 & a &= + \quad 0.256\ (\text{wt.} = 2.83) \\
dc\, \Delta &+ 0.015 & c &= + \quad 0.215\ (\text{wt.} = 19.22)
\end{aligned}
$$

Ogden, September 22, 1878; after signals.

Name of star.	Clamp	T.	B*b*.	A*a*.	C*c*.	T′.	A. R.	ΔT.
		h. m. s.	*s.*	*s.*	*s.*	*h. m. s.*	*h. m. s.*	*m. s.*
27 Pegasi	E.	22 6 34.91	+ 0.14	+ 0.07	+ 0.22	22 6 35.34	22 3 52.98	− 2 42.36
24 Cephei	E.	10 12.92	+ 0.32	− 0.60	+ 0.59	10 13.23	22 7 30.93	2 42.30
1 Lacertæ	E.	13 24.50	+ 0.15	+ 0.03	+ 0.23	13 24.91	22 10 42.74	2 42.17
31 Pegasi	E.	18 16.65	+ 0.11	+ 0.19	+ 0.19	18 17.14	22 15 34.73	2 42.41
Gr. 3804	W.	29 49.12	+ 0.07	+ 0.02	− 0.24	29 48.97	22 27 6.59	2 42.38
Pi. XXII, 158	W.	32 43.02	+ 0.05	+ 0.14	− 0.19	32 43.02		
31 Cephei	W.	35 32.74	+ 0.16	− 0.67	− 0.64	35 31.59	22 32 49.24	2 42.35
η Pegasi	W.	40 3.16	+ 0.06	+ 0.08	− 0.21	40 3.09	22 37 20.93	2 42.16
λ Pegasi	W.	22 43 25.59	+ 0.06	+ 0.13	− 0.20	22 43 25.58	22 40 43.23	− 2 42.35

NORMAL EQUATIONS.

$a_0 = +0^s.40 \qquad c_0 = +0^s.20 \qquad \Delta T_0 = -2^m\,42^s.31$ for $22^h.4$

$$\begin{aligned} &\quad s. \\ 0 &= -0.007 + 6.15\,d\Delta T + 0.29\,da + 0.00\,dc \\ 0 &= +0.070 + 0.29\,d\Delta T + 2.23\,da + 0.26\,dc \\ 0 &= +0.199 + 0.00\,d\Delta T + 0.26\,da + 14.15\,dc \end{aligned}$$

$$\begin{aligned} & \qquad\quad s. & & \qquad\quad m.\ \ s. \\ d\Delta T &= +0.003 & \Delta T &= -2\ 42.307\ (\text{wt.} = 6.11) \\ da &= -0.030 & a &= +\ 0.370\ (\text{wt.} = 2.21) \\ dc &= -0.014 & c &= +\ 0.186\ (\text{wt.} = 14.12) \end{aligned}$$

(FORM No. 12.)

Signals sent from—	Recorded at—	Mean of signals sent and received.	Time correction.	Corrected time.	Difference of longitude.	Double wave time.	Means.
		h. m. s.	m. s.	h. m. s.	m. s.	s.	m. s.
September 5, 1878:							
Ogden	Ogden	20 11 50.00	— 2 51.044	20 8 58.956			
	Dalles	19 32 19.44	— 10.944	19 32 8.496	36 50.460		
Dalles	Ogden	20 16 20.22	— 2 51.056	20 13 29.164			
	Dalles	19 36 49.60	— 10.944	19 36 38.656	36 50.508	+ 0.048	36 50.484
September 17, 1878:							
Ogden	Ogden	21 26 50.00	— 2 50.569	21 23 59.431			
	Dalles	20 47 16.27	— 5.851	20 47 10.419	36 49.012		
Dalles	Ogden	21 31 29.17	— 2 50.566	21 28 38.604			
	Dalles	20 51 55.20	— 5.851	20 51 49.349	36 49.255	+ 0.248	36 49.134
September 20, 1878:							
Ogden	Ogden	21 26 35.00	— 2 45.907	21 23 49.093			
	Dalles	20 47 6.49	— 6.826	20 46 59.664	36 49.429		
Dalles	Ogden	21 30 22.95	— 2 45.902	21 27 37.048			
	Dalles	20 50 54.20	— 6.826	21 50 47.374	36 49.674	+ 0.245	36 49.552
September 21, 1878:							
Ogden	Ogden	21 24 5.00	— 2 44.031	21 21 20.969			
	Dalles	20 44 38.02	— 6.637	20 44 31.383	36 49.586		
Dalles	Ogden	21 27 47.44	— 2 44.026	21 25 3.414			
	Dalles	20 48 20.10	— 6.636	20 48 13.464	36 49.950	+ 0.364	36 49.768
September 22, 1878:							
Ogden	Ogden	21 42 30.00	— 2 42.347	21 39 47.653			
	Dalles	21 3 4.44	— 6.280	21 2 58.160	36 49.493		
Dalles	Ogden	21 46 19.21	— 2 42.343	21 43 36.867			
	Dalles	21 6 53.30	— 6.280	21 6 47.020	36 49.847	+ 0.354	36 49.670

		m.	s.
Final difference of longitude,		36	49.722
	°	′	″
=	9	12	25.83
Add longitude of Ogden,	111	59	54.64
longitude of Dalles,	121	12	20.47

Mean place of stars for 1878.0 *used for the determination of latitude of The Dalles, Oreg.*

No. of combination.	No. B. A. C.	Class.	R. A.			Declination.		
			h.	*m.*	*s.*	°	′	″
1	(1)	B	18	5	18	66	55	45.9
	6223	A	18	14	10	24	23	47.6
2	6246	B	18	17	5	51	17	41.5
	6268	A		20	13	39	26	30.0
3	6255	A	18	18	25	49	3	38.8
	(2)	B	18	20	24	42	24	7.0
4	6335	B	18	29	24	52	1	28.3
	6357	B	18	34	5	39	33	42.1
5	6372	A	18	37	5	52	4	54.1
	(3)	B	18	39	12	39	10	43.1
	(4)	C	18	36	4	52	14	1.1
	6390	A	18	40	18	39	32	35.9
	6391	A	18	40	20	39	29	9.0
6	6428	B	18	45	3	48	37	44.5
	(5)	A	18	49	40	42	45	3.1
7	6427	A	18	45	20	32	24	41.1
	6463	AA	18	49	24	59	14	22.2
8	6468	A	18	50	24	33	48	49.6
	6477	C	18	51	39	57	19	56.0
	6496	B	18	54	41	57	39	12.8
9	6522	B	18	58	18	55	29	2.2
	6556	A	19	2	57	35	54	35.3
10	6599	A	19	12	8	37	55	1.9
	6623	AA	19	14	17	53	8	38.0
11	(6)	C	19	18	48	64	9	36.1
	6690	A	19	25	48	27	42	16.3
	6691	A	19	25	50	27	42	35.7
12	6717	C	19	30	20	48	59	50.8
	6718	C	19	30	43	42	8	47.1
13	6730	A	19	32	40	49	57	56.5
	6734	A	19	33	10	49	56	21.1
	6769	C	19	39	41	41	28	52.0
14	6741	C	19	34	33	40	0	9.0
	6745	B	19	35	28	42	32	14.1
15	6780	C	19	40	52	57	43	33.9
	6784	A	19	41	48	33	26	40.7
	6800	C	19	44	11	33	7	58.9
16	6806	B	19	45	8	38	24	13.5
	6813	B	19	46	15	38	24	33.6
	6824	B	19	47	34	52	40	43.8
	6856	A	19	52	28	52	6	56.1
17	6881	C	19	56	2	51	43	19.3
	6918	C	20	1	48	51	29	24.7
	6959	B	20	9	8	51	5	50.2
	6986	B	20	12	35	39	59	18.0
	7022	A	20	17	51	39	52	1.3
18	7029	A	20	18	59	31	47	49.3
	7060	B	20	22	33	59	12	6.3
19	7064	B	20	23	26	56	14	13.4
	7105	C	20	28	48	56	21	57.9
	7103	A	20	29	9	34	50	2.0
20	7158	C	20	33	45	52	32	51.6
	7167	C	20	36	26	38	38	54.4
	7218	B	20	42	49	52	33	4.8
21	7332	C	21	0	4	52	48	1.7
	7336	AA	21	1	26	38	9	1.3
	7337	AA	21	1	27	38	8	52.2
	7365	A	21	6	29	53	3	55.3
22	7373	B	21	8	32	36	7	49.6
	7401	B	21	13	35	55	17	9.5
	7453	A	21	20	48	36	8	27.3
23	7505	A	21	29	48	37	59	15.8
	7530	C	21	33	35	53	29	34.7
	7566	A	21	38	23	37	43	32.5
	(7)	B	21	38	34	37	44	50.3
24	7614	B	21	46	2	38	57	57.5
	7646	C	21	51	13	52	39	53.8
	7676	B	21	57	22	52	17	40.2
25	7718	C	22	3	3	58	14	43.9
	7721	A	22	3	49	32	34	36.4
	7731	A	22	4	34	32	34	47.9
	7736	B	22	4	28	58	41	45.5
	7755	B	22	7	22	58	48	46.9
26	7749	A	22	6	37	57	36	0.8
	7753	B	22	7	24	34	0	12.7
27	7770	C	22	9	37	42	20	58.3
	7820	B	22	19	34	48	51	29.1
	7850	B	22	25	13	42	29	54.2
28	7888	B	22	32	22	50	54	56.2
	7917	C	22	36	9	40	54	36.1
29	7995	B	22	51	5	49	4	56.6
	8028	B	22	56	59	42	6	5.8
	8036	A	22	58	42	49	23	20.8
30	8059	B	23	2	13	48	37	52.9
	8076	B	23	4	49	42	53	20.9
	8082	A	23	6	58	48	44	23.7
	8114	B	23	12	5	48	20	57.8
31	8125	A	23	13	49	47	57	22.8
	8135	B	23	14	58	43	26	59.1
32	8153	B	23	17	6	59	27	53.4
	8159	A	23	18	53	31	42	53.7

---

[1] Sd. 745. [2] Sd. 779. [3] Sd. 812. [4] Sd. 806. [5] Sd. 843. [6] Sd. 923. [7] Sd. 1364.

Observations and computations for latitude, of The Dalles, Oregon.

Date.	Number of star.	Micrometer readings.	Level.		Half sum of declination.	Corrections.			Latitude.
			N.	S.		Micr. and refr.	Level.	Merid.	
					° ′ ″	′ ″	″		° ′ ″
ptember 5, 1878....	6246 6268	5.845 26.658	19.5 9	12 22	45 22 18.5	+14 2.9	−2.0	....	45 36 19.4
	6335 6357	25.520 8.468	17 13	15 18	45 47 48.9	−11 30.6	−1.1	....	17.2
	6372 (³)	13.370 10.785	16 14.5	15 17	45 38 2.6	−1 44.7	−0.5	....	17.4
	6427 6463	3.490 23.395	17 9	15 23.5	45 49 45.8	−13 26.2	−4.5	....	15.1
	6522 6556	20.765 12.300	15.5 13.5	16 18	45 42 3.9	− 5 42.8	−1.8	....	19.3
	6599 6623	21.095 14.773	16.5 12.5	15 19.5	45 32 5.9	+ 4.16.0	−2.0	....	19.9
ember 6, 1878....	(¹) 6223	19.880 14.360	16.5 20	18 14	45 39 58.0	− 3 43.6	+1.6	....	16.0
	6335 6357	24.595 7.440	14.5 19	20 16	45 47 49.0	−11 34.8	−0.9	....	13.3
	6427 6463	6.425 26.485	13 26	22 9	45 49 46.0	−13 32.4	+2.9	....	16.5
	6522 6556	19.760 11.135	19 20	16.5 15	45 42 4.0	− 5 49.3	+2.7	....	17.4
	6599 6623	21.055 14.870	16.5 21.5	19 14	45 32 6.0	+ 4 10.5	+1.8	....	18.3
	(⁶) 6690 6691	31.755 2.195 1.955	20.5 17	15 19	45 56 17.0	−20 2.0	+1.3	....	16.3
	6730 6734 6769	21.260 20.070 10.180	...... 17.5 22.5	...... 18 13	45 43 17.8	− 7 4.4	+3.2	....	16.6
	6780 6784 6800	12.505 13.795 27.640	16.5 21.5	19 14	45 30 44.1	+ 5 32.6	+1.8	....	18.5
	6813 6824 6856	29.725 24.825 *− 0.700	18 20	18 16	45 24 29.6	+11 47.2	+1.4	....	18.2
	6881 6918 6959 6986 7022	30.080 19.735 2.255 7.285 12.670	21 .... 18	15 .... 18	45 41 14.3	− 4.58.9	+2.2	....	17.6
	7029 7060	18.275 9.330	19.5 19	17 17	45 30 16.7	+ 6 2.3	+1.6	....	20.6
	7064 7103	12.920 18.575	18 19.5	18 17	45 32 27.0	+ 3 49.0	+0.9	....	16.9
	7153 7167 7218	15.330 15.410 15.590	18 21 19 21	18 16 18 16	45 36 16.1	− 0 2.0	+2.3	....	16.4
	7332 7336 7337 7365	8.360 19.290 19.410 20.240	20 ...... 19	18.5 ...... 18	45 32 49.3	+ 3 24.5	+1.3	....	15.1
	7373 7401 7453	10.475 20.305 10.035	18 24	19 13	45 42 59.8	− 6 47.0	+3.6	....	45 36 16.4

* Reading, −1 +.700.

Observations and computations for latitude of The Dalles, Oregon.

Date.	Number of star.	Micrometer readings.	Level.		Half sum of declination.	Corrections.		
			N.	S.		Micr. and refr.	Level.	Merid.
					° ′ ″	′ ″	″	
September 6, 1878....	7505	8. 155	16	21. 5	45 40 50. 7	− 4 38. 0	+2. 4	....
	7530	20. 855	25	12				
	7566	10. 825	15 25	22 12				
	7614	8. 460	18	19	45 43 43. 7	− 7 31. 6	+4. 0	....
	7646	27. 860	25	13				
	7676	11. 360	....	......				
	7749	27. 060	21	17	45 48 28. 3	−12 13. 9	+2. 2	....
	7753	8. 940	20	18				
	7770	2. 045	18	19	45 36 35. 5	− 0 20. 7	+3. 2	....
	7820	2. 555	24	14				
	7888	28. 455	20	17. 5	45 55 7. 9	−18 54. 6	+2. 7	....
	7917	*− 0. 440	21. 5	16. 5				
	7995	14. 040	20	18	45 40 29. 0	− 4 15. 4	+3. 2	....
	8028	14. 570	21. 5	16. 5				
	8036	27. 710	22	16				
	8059	20. 965	17	21. 5	45 41 44. 7	− 5. 32. 0	+3. 2	....
	8076	6. 425	26. 5	12				
	†8082	25. 720	16	22. 5				
	8114	8. 280	......	......				
	8125	20. 220	18. 5	20	45 42 32. 5	− 6 19. 9	+2. 3	....
	8135	10. 840	23	15				
	8153	‡20. 485	19	19. 5	45 35 44. 9	− 0 31. 2	+2. 3	....
	8159	16. 255	22. 5	15. 5				
September 7, 1878....	(1)	20. 350	19	18	45 39 58. 1	− 3 46. 6	+1. 8	....
	6223	14. 755	20. 5	16. 5				
	6255	23. 708	21. 5	16	45 44 6. 0	− 7 50. 3	+3. 1	....
	(2)	12. 095	20	17				
	6335	23. 755	18	19	45 47 49. 1	−11 35. 4	+2. 3	....
	6357	6. 585	22. 5	15				
	6372	13. 350	20	17. 5	45 38 2. 8	− 1 50. 0	+2. 5	....
	(3)	10. 635	21	16. 5				
	6427	5. 130	19. 5	17. 5	45 49 46. 1	−13 33. 0	+2. 7	....
	6463	25. 205	21. 5	16				
	6468	12. 905	18	19. 5	45 44 16. 0	− 8 0. 9	+3. 4	....
	6496	24. 780	24	13				
	6522	23. 065	18	19	45 42 4. 2	− 5 50. 3	+3. 4	....
	6556	14. 415	24	13. 5				
	6599	13. 560	19	19	45 32 6. 2	+ 4 13. 5	−0. 5	....
	6623	7. 300	18	19. 5				
	6717	16. 080	......	......	45 34 35. 8	+ 1 42. 5	−0. 2	....
	6718	18. 610	......	......				
	6741	24. 560	17	21	45 46 29. 2	−10 12. 6	0. 0	....
	6745	9. 435	21	17				
	6780	11. 865	19	19	45 30 44. 3	+ 5 34. 9	−0. 4	....
	6784	13. 210	18. 5	19. 5				
	6800	27. 060	......	......				
	6806	28. 665	......	......	45 24 24. 8	+11 54. 4	0. 0	....
	6813	28. 420	19	18				
	6324	23. 430	......	......				
	6856	§−3. 375	18. 5	19. 5				
	6881	31. 350	18. 5	19. 5	45 41 14. 2	− 4 57. 0	+0. 2	....
	6918	21. 040	20	18				
	6959	3. 535	18	20				
	6986	8. 595	20	18				
	7022	14. 020	......	......				

Probably 0 440. 8082 in error; cannot find what the error is. ‡ 15r.485. § Should be −2

Observations and computations for latitude of The Dalles, Oreg.—Continued.

Date.	Number of star.	Micrometer readings.	Level.		Half sum of declination.	Corrections.			Latitude.
			N.	S.		Micr. and refr.	Level.	Merid.	
					° ′ ″	′ ″	″		° ′ ″
tember 7, 1878....	7029	18.780	19	19	45 30 16.9	+ 6 0.0	+1.4	....	45 36 18.3
	7060	9.890	21	17					
	7153	15.830	19.5	19	45 36 16.3	+ 0 1.8	+0.1	....	18.2
	7167	15.970	19	20					
	7218	16.020	19 20	20 18					
	7332	8.095	21	18	45 32 49.5	+ 3 26.4	+1.6	....	17.5
	7336	19.015	20.5	19					
	7337	19.115	......	......					
	7365	19.840	......	......					
	7373	11.395	19.5	19	45 43 0.1	− 6 44.9	+1.4	....	16.6
	7401	21.155	21.5	18					
	7453	10.920	......	......					
	7505	6.220	21	18	45 40 51.0	− 4 35.7	+1.1	....	16.4
	7530	18.850	20	20					
	7566	17.865	......	......					
	7614	8.225	19.5	20	45 43 44.0	− 7 27.1	+0.9	....	17.8
	7646	27.495	21	18					
	7676	11.035	......	......					
	7718	2.415	......	......	45 35 12.9	+ 1 4.3	+0.8	....	18.0
	7721	19.096	......	......					
	7731	18.950	......	......					
	7736	22.270	......	......					
	7755	27.620	......	......					
	7770	17.000	21	19	45 38 49.8	− 2 31.4	+0.4	....	18.8
	7820	17.440	20	20					
	7850	10.405	20.5	20					
	7888	30.955	21.5	19	45 55 8.2	−18 52.2	+0.7	....	16.7
	7917	3.000	20	20.5					
tember 9, 1878....	(4)	28.877	19	16.5	45 47 3.0	−10 46.4	+1.6	....	18.2
	6372	22.105	......	......					
	(3)	19.510	......	......					
	6391	5.824	......	......					
	6390	3.260	19	17					
	6428	21.510	20	16	45 41 39.0	− 5 20.0	−0.7	....	18.3
	(5)	13.610	14	22					
	6522	22.300	20	16.5	45 42 4.5	− 5 47.5	−0.9	....	16.1
	6556	13.720	15	21					
	6599	17.370	16.5	20	45 32 6.5	+ 4 12.3	−0.7	....	18.1
	6623	11.140	19	17.5					
	(6)	33.860	22	15	45 56 17.5	−19 58.5	−2.0	....	17.0
	6690	4.385	......	......					
	6691	4.148	12	24.5					
	6717	14.135	22	15	45 34 36.2	+ 1 44.1	−2.2	....	18.1
	6718	16.705	12	25					
	*6734	18.953	21.5	15.5	45 42 54.5	− 6 34.8	−1.8	....	17.9
	6769	14.205	13	24					
	6780	11.150	18	19	45 30 44.6	+ 5 34.3	−0.7	....	18.2
	6784	12.465	18	19					
	†6800	21.345	......	......					
	6806	29.980	......	......	45 24 25.2	+11 56.1	−1.8	....	19.5
	6813	29.725	20.5	16.5					
	6824	24.725	......	......					
	‡6856	− 60.615	14	23					
	6881	29.795	......	......	45 41 15.0	− 4 55.2	−1.3	....	45 36 18.5
	6918	19.490	19	18					
	6959	2.005	......	......					
	6986	7.115	16.5	21					
	7022	12.500	......	......					

* Error of 5^r in this pair. † 6800 should read 26^r.345. ‡ 6856 should read $-1^r + .615$.

Observations and computations for latitude of The Dalles, Oreg.—Continued.

Date.	Number of star.	Micrometer readings.	Level.		Half sum of declination.	Corrections.			Latit
			N.	S.		Micr. and refr.	Level.	Merid.	
					° ′ ″	′ ″	″		° ′
September 9, 1878....	7029	20.435	19	18.5	45 30 17.4	+ 6 3.1	0.0	....	45 3
	7060	11.470	18.5	19					
	*[7064	13.470]	19	18.5	45 36 20.0	− 0 0.5	−0.9	....	
	7103	19.287	16	22					
	7105	19.300	......	......					
	7153	15.850	21	17	45 36 16.8	+ 0 4.2	−2.2	....	
	7167	16.050	14	24					
	7218	16.045	......	......					
	7332	8.500	19.5	20	45 32 50.0	+ 3 31.1	−3.2	....	
	7336	19.669	......	......					
	7337	19.790	15	23.5					
	7365	20.445	......	......					
	7373	18.880	20	18	45 43 0.6	− 6 38.6	−2.5	....	
	7401	28.460	15	24					
	7453	18.355	......	......					
	7505	7.175	21.5	17	45 39 45.9	− 3 24.9	−2.9	....	
	†7530	24.670	13	25.5					
	7556	18.810	......	......					
	(?)	17.850	......	......					
	7614	6.905	19	20	45 43 44.6	− 7 22.6	−2.9	....	
	7646	26.085	16	23					
	7676	9.580	......	......					
	......	Lost	......	......					
	7749	25.645	21	18	45 48 29.2	−12 12.2	−1.3	....	
	7753	7.565	16.5	23					
	7770	17.330	20.5	18.5	45 38 50.4	− 2 31.3	−1.3	....	
	7820	17.740	17	22.5					
	7850	10.680	......	......					
	*a*7888	29.195	22	17	45 55 8.8	−18 50.4	−1.6	....	
	7917	2.290	15	24.5					
	7995	11.330	{21.5	18.5	45 40 29.9	....	−0.2	....	......
	*b*8028	31.145	}18	22					
	8036	24.970	22	18					
	8059	21.330	19	21	45 44 15.3	− 7 54.1	− 2.7	....	
	8076	7.020	18	22					
	8082	26.150	......	......					
	8114	8.700	......	......					
	8125	21.693	19	21	45 42 33.4	− 6 12.2	−2.7	....	
	8135	12.505	......	......					
	8153	16.920	......	......	45 35 45.8	− 34.0	(?)	....	(
	8159	17.760	......	......					
	6335	!19.490	24.5	12	45 47 50.0	−11 34.4	+0.7	....	
September 17, 1878...	6357	2.345	13	23.5					
	6372	22.025	......	......	45 44 47.0	− 8 32.5	+0.7	....	
	(?)	19.355	......	......					
	6391	5.655	......	......					
	6390	3.100	......	......					
	6427	8.085	18	19	45 49 47.2	−13 34.5	+3.4	....	
	6463	28.195	23.5	13					
	6468	13.235	18	18.5	45 39 27.9	− 3 10.2	+1.6	....	
	6477	10.770	......	......					
	6496	25.095	21	16					
	6522	20.020	19	18	45 42 5.4	− 5 47.9	+1.3	....	45
	6556	11.430	19.5	17					

---

* I have omitted 7064; its result with 7103 will be 45° 36′ 22″.4. Perhaps the error is 0r.1, reading 13r.570. See September 6. †7530 should read 19r.670.

a Difference increased 1r. *b* Some great error in 8028; the reading should be about 11r.92

Discussion of latitude—Dalles.

Combination.	No. of obs.	No. of stars.	Latitude.	Cor. to micr.	Combination.	No. of obs.	No. of stars.	Latitude.	Cor. to micr.
			° ′ ″	″				° ′ ″	″
1	2	2	45 36 14.65	+0.34	17	3	5	45 36 17.83	+0.44
2	1	2	19.4	—1.26	18	3	2	19.80	—0.54
3	1	2	18.8	+0.70	19	2	3	17.75	—0.17
4	4	2	15.82	+1.04	20	3	3	17.80	0.00
5	4	5	16.52	+0.51	21	3	4	17.17	—0.31
6	1	2	18.3	+0.48	22	3	3	17.50	+0.60
7	4	2	15.88	+1.22	23	3	4	16.53	+0.38
8	2	3	18.90	+0.50	24	3	3	17.67	+0.66
9	5	2	17.78	+0.52	25	1	5	18.0	—0.10
10	4	2	18.88	+0.38	26	2	2	16.15	+1.10
11	2	3	16.65	+1.80	27	3	3	18.20	+0.16
12	2	2	18.10	—0.15	28	3	2	16.50	+1.70
13	2	3	17.25	+0.60	29	1	3	16.8	+0.38
14	1	2	16.60	+0.91	30	2	4	17.20	+0.60
15	3	3	18.50	—0.50	31	2	2	16.70	+0.57
16	3	4	18.97	—1.07	32	2	2	16.00	+0.04

Final latitude, 45° 36′ 17″.78 ± 0″.09.

ASTRONOMICAL STATION AT FRESNO, CAL., 1878.

GEOGRAPHICAL POSITION.

Latitude 36° 43′ 31″.22.

Longitude ———.

Barometric altitude of observatory above sea-level (Lieutenant Ludlow's camp), 313.7 feet.

Discrepancies were found in the time observations at Fresno, which could not be cleared up owing to lack of time. The discussion of the longitude is therefore omitted in this place.

ASTRONOMICAL STATION AT FRESNO, CAL., OCTOBER, 1878.

GEOGRAPHICAL POSITION.

The location of the observatory was on a swell of ground some half mile south of the town. The pier was of cemented brick, as at the other stations. There was no lava-bed here as at The Dalles, nor bowlders as at Walla Walla, loaded with magnetic iron, to affect the needle, the soil being composed almost entirely of sand. It is seldom possible to get such a desirable spot, in all respects, for an observatory as was here presented. The view was unobstructed in all directions, bounded eastward at a great distance by Mounts Whipple, Goddard, and other great mountain masses of the Sierra Nevada, while westward lay the Coast Range.

FRESNO AND ITS SURROUNDINGS.

Fresno is a town that owes its origin to the Southern Pacific Railroad. It is the capital of the county of that name, which is often designated in California as the county of colonies. The court-house is an expensive and showy building, and stands out in marked contrast with all other improvements, both public and private. At this season of the year there seemed to be no vegetation here—nothing green—except that produced by irrigation.

METEOROLOGICAL CONDITIONS.

The pier and tent were in readiness for observations by October 1, and it was continuously clear till the 11th, when it rained, as also on the 13th and 14th. There was little or no wind, and no dust to interfere, notwithstanding the sandy soil.

TELEGRAPHIC COMMUNICATIONS.

Ogden was got by way of San Francisco, and there being no delay in the use of the wires, longitudinal exchanges, with complete clock error, could have been had every night from October 4 to 11 had the conditions of the former place been equally favorable.

METHOD OF OBSERVATION.

Same as at other stations.

INSTRUMENTS.

Also the same.

ADDENDA.

The elaborate stone pillars sent to Fresno for marking the meridian were placed, the one in the meridian north of the pier, just north of the railroad track and on a line with the first row of houses facing south; the other about the same distance southward, and near a road leading to one of the colonies.

Mean place of stars for 1878.0 *used for the determination of latitude of Fresno, Cal.*

No. of pair.	No. B. A. C.	Class.	A. R.			Declination.		
			h.	m.	s.	°	′	″
	6480	A	18	52	27	32	44	44.4
	6491	A	18	54	23	32	31	23.8
	6493	C	18	54	47	40	30	45.8
	6674	A A	19	23	38	24	25	8.5
	6717	C	19	30	20	48	59	50.8
	6720	C	19	30	52	43	40	41.6
	6728	C	19	32	39	43	26	1.6
	6740	A	19	34	33	29	52	23.4
	6784	A	19	41	48	33	26	40.7
	6800	C	19	44	11	33	7	58.9
	6817	B	19	46	26	40	17	24.3
	6857	B	19	52	59	40	2	26.7
	(1)	C	19	53	40	56	21	34.8
	6868	A	19	54	33	17	11	3.6
	6928	A	20	3	1	52	48	20.1
	6933	A	20	4	34	20	33	13.0
	6944	A	20	6	54	26	6	56.1
	6983	A	20	11	42	47	20	24.4
	7041	B	20	21	11	42	12	23.0
	7100	C	20	28	37	42	46	35.2
	7131	A	20	32	34	31	8	49.6
	7132	A	20	32	35	31	5	51.5
	7164	A	20	36	6	31	52	26.8
	7174	C	20	37	32	41	16	50.4
	7204	A A	20	41	16	33	30	50.9
	7260	B	20	49	49	40	14	21.4
	7313	A	20	57	40	39	1	42.8
	7399	B	21	12	54	34	23	7.5
	7411	B	21	15	17	48	59	41.7
	7437	A	21	18	29	23	45	2.7
	7461	A	21	22	18	27	4	41.0
	7480	A	21	24	57	46	0	11.2
	7520	A	21	32	3	18	46	13.5
	7555	C	21	36	41	54	19	4.2
	7571	A	21	39	7	25	5	5.6
	7598	A	21	42	17	48	44	43.8
	7627	A A	21	47	31	25	21	6.3
	(3)							
	7676	B	21	57	22	52	17	40.2
	7699	B	22	0	13	62	31	34.7
	7707	A	22	1	18	62	11	26.4
	(4)							
	7789	B	22	14	14	62	11	35.0
	7796	A	22	15	31	11	35	27.7
	7798	A	22	15	41	27	42	59.3
	7800	B	22	15	50	45	55	20.8
	7833	(B)	22	22	54	[7]8	29	29.2
	7837	B	22	23	10	64	30	37.3
	7902	A	22	34	19	62	57	1.6
	7908	A A	22	35	23	10	11	41.9
	7967	A	22	45	20	65	33	31.5
	7988	(B)	22	48	95	[7]8	9	56.5
	8034	A A	22	58	41	14	32	56.9
	8054	B	23	1	28	58	45	38.1
	(5)	C	23	4	39	16	56	2.5
	8083	A	23	7	25	56	29	41.4
	8138	B	23	15	15	61	32	42.4
	8182	A	23	22	59	12	5	15.4
	8206	A	23	27	54	30	39	7.1
	8229	A	23	32	9	42	35	33.8
	(6)	C	23	36	36	[9]63	50	20.2
	8250	(B)	23	37	10	[7]9	39	15.0
	8273	A	23	42	5	67	7	44.2
	8331	A A	23	53	3	[8]6	11	16.3
	8344	A	23	55	24	60	32	36.1
	8366	B	23	58	48	60	38	4.7
	8370	A	23	59	26	12	43	2.2

[1] Sd. 1052.
[2] Gr. 3157.
[3] D. M. 20°. 5046.
[4] 54* Heis Pegasi.
[5] Sd. 1595.
[6] Gr. 4130.
[7] Position from Ay. 64 (preliminary).
[8] Position from mean of G. and B.
[9] See Fort Bayard, 9.

For 3 and 4 no accurate positions were available.

Observations and computations for latitude, Fresno, Cal.

Date.	Number of star.	Micrometer readings.	Level.		Half sum of declination.	Corrections.			Latitude.
			N.	S.		Micr. and refr.	Level.	Merid.	
					° ′ ″	′ ″	″		° ′ ″
ober 3, 1878	6674	8.720	26	8	36 42 48.2	+ 0 43.3	+0.7	....	36 43 32.2
	6717	7.650	9	25					
	6728	9.200	16.5	17.5	36 39 31.9	+ 3 58.3	+1.4	....	31.6
	6740	15.085	19.5	14.5					
	a6784	3.110	......	......	36 52 22.7	− 8 55.0	+3.6	....	31.3
	6800	16.985	19	15	36 35 33.4	+ 7 56.5	+3.6	....	33.5
	6817	16.320	20	14					
	6857	5.220	......	......					
	6928	8.018	18	16.5	36 41 7.8	+ 2 17.0	+5.4	....	30.2
	6933	11.400	24	10.5					
	6944	8.850	18.5	17	36 44 2.2	− 0 33.6	+3.8	....	32.4
	6983	9.680	22	13					
	7164	14.848	14	21	36 35 2.6	+ 8 24.8	+4.9	....	32.3
	7174	2.385	28	7.5					
	7204	0.680	16	19	36 53 0.7	− 9 32.7	+2.5	....	30.5
	7260	14.820	23	13					
	7313	4.475	19	17.5	36 42 50.9	+ 0 35.0	+4.7	....	30.6
	7399	5.340	24	12.5					
	7461	23.060	16	20.5	36 32 52.6	+10 34.8	+4.5	....	31.9
	7480	7.385	27	10					
	7520	25.530	12	24.5	36 33 5.3	+10 21.1	+4.1	....	30.5
	7555	10.195	......	......					
	7571	11.980	b18	18	36 59 22.3	−15 55.6	−1.8	....	[24.9]
	7598	29.645	16	21					
	7627	10.120	......	.....					
	......	25.750	c13	24					
	7676	4.500	......	.....					
tober 4, 1878	6480	15.340	13	18	36 34 40.9	+ 8 46.3	+5.0	....	32.2
	6491	25.230	25	6					
	6493	7.290	....	.....					
	6674	15.240	14	18.5	36 42 48.2	+ 0 42.5	+2.9	....	33.6
	6717	14.190	22.5	10					
	6728	12.535	17	16	36 39 31.9	+ 3 57.9	+2.9	....	32.7
	6740	18.410	20	13					
	6784	8.910	......	......	36 52 22.7	− 8 56.4	+2.9	....	29.2
	6800	22.815	11	22	36 35 33.5	+ 7 55.3	+2.9	....	31.7
	6817	22.155	d26	27					
	e6857	6.080	......	......					
	7041	5.450	......	......	36 48 48.4	− 5 17.0	−0.4	....	31.0
	7100	30.840	23	11					
	f7131	11.430	10.5	23.5					
	f7132	9.205	......	......					
	7164	20.725	18	16	36 35 2.7	+ 8 29.7	−0.4	....	32.0
	7174	8.140	16	19					
	7204	7.525	17	17	36 53 0.8	− 9 33.7	+0.5	....	27.6
	7260	21.690	18	16.5					
	7313	7.535	20	15	36 42 51.0	+ 0 38.5	+1.4	....	30.9
	7399	8.485	17	18					
	7411	g− 1.860	18.5	17	36 22 48.3	+20 41.9	−0.7	....	36 43 29.5
	7437	29.525	16.5	19					

a Paired thus, 6784, 6817, 6800, 6857.

b Some error in the level readings.

c Level reading incomplete.

d Level should be 26 N., 7 S.

e (6857) should read 11.080.

f The readings for 7131 and 7132 are questioned by the observer, but are correct.

g Reading, $-2^{r}.+0^{r}.860$.

Observations and computations for latitude, Fresno, Cal.—Continued.

Date.	Number of star.	Micrometer readings.	Level.		Half sum of declination.	Corrections.			Latitude.
			N.	S.		Micr. and refr.	Level.	Merid.	
					° ′ ″	′ ″	″		° ′ ″
October 4, 1878	7461	22. 920	16	19	36 32 52. 7	+10 39. 3	+1. 4	....	36 43 33. 4
	7480	7. 135	21	14					
	7520	− 2. 603	11. 5	24	36 33 5. 4	(*a*)	+2. 7	....	(*a*)
	7555	24. 290	28	8					
	7571	12. 350	......	......	36 59 22. 3	−15 54. 6	+2. 2	....	29. 9
	7598	30. 000	17	18					
	7627	0. 508	21	14					
	......	26. 535	12	24					
	7676	5. 258	26	9					
	7699	27. 285	......	......					
	7707	12. 330	21. 5	15					
	......	21. 995	17	18. 5					
	7798	13. 385	15	21. 5	36 49 39. 6	− 6 11. 1	+2. 0	....	30. 5
	7800	22. 548	24	12					
	7833	22. 375	13	24	36 30 58. 0	+12 26. 0	+4. 7	....	28. 7
	7837	3. 955	30	6					
	7902	7. 390	24	13	36 34 49. 6	+ 8 40. 2	+1. 8	....	31. 6
	7908	20. 235	15. 5	21. 5					
	7967	19. 750	18	19	36 52 11. 9	− 8 43. 1	+1. 4	....	30. 2
	7988	6. 835	21	16					
	8034	16. 100	16. 5	21	36 39 46. 1	+ 3 46. 4	+1. 8	....	34. 3
	8054	10. 510	23. 5	14					
	......	14. 450	16	21	36 43 20. 8	+ 0 8. 5	+2. 2	....	31. 5
	8083	14. 240	24	13					
	8138	2. 195	18	19	36 49 27. 5	− 1	+2. 2	....	....
	8182	4. 090	22	15					
	8206	18. 698	16	21	36 37 49. 8	+ 5 41. 4	+1. 6	....	32. 8
	8229	10. 268	23. 5	14					
	......	17. 780	16	21	36 45 16. 7	− 1 46. 3	+0. 7	....	31. 1
	8250	15. 155	22	15					
	8273	10. 900	24	13. 5	36 39 58. 2	+ 3 31. 2	+2. 0	....	31. 4
	8331	16. 115	16. 5	21. 5					
	[b]8344	13. 680	......	......	36 39 39. 7	+ 3 50. 5	+1. 7	....	31. 9
	8366	16. 745	......	......					
	8370	20. 405	......	......					
October 10, 1878	7902	7. 990	23	16	36 34 50. 6	+8 45. 1	+2. 9	....	38. 6
	7908	20. 955	20	19					
	7967	20. 815	28. 5	10. 5	36 52 12. 9	−8 46. 1	+2. 5	....	29. 3
	7988	7. 825	14	25					
	8034	16. 355	21	18. 5	36 39 47. 2	+3 45. 0	+0. 5	....	32. 7
	8054	10. 800	19	20					
	......	13. 388	18	21. 5	36 43 22. 0	+0 8. 4	+0. 7	....	31. 1
	8083	13. 180	22. 5	17					
	[c]8138	11. 850	24	15	36 49 28. 7	−6 3. 3	+1. 6	....	27. 0
	......	14. 880	16. 5	23					
	8149	22. 760	......	......	36 38 14. 8	+5 20. 4	+1. 6	....	36. 8
	8162	14. 850	24	15					
	8182	2. 880	18. 5	21					
	8206	18. 490	15. 5	23. 6	36 37 51. 1	+5 36. 8	+1. 9	....	36 43 29. 8
	8228	10. 175	26. 5	13					

a I cannot find what error has been made here.
b 8344 should read 12ʳ.
c Paired thus, 8138, 8182; 8149, 8162. The fifth star I cannot identify with any well-known one.

Observations and computations for latitude, Fresno, Cal.—Continued.

Date.	Number of star.	Micrometer readings.	Level.		Half sum of declination.	Corrections.			Latitude.
			N.	S.		Micr. and refr.	Level.	Merid.	
					° ′ ″	′ ″	″		° ′ ″
October 10, 1878	......	18. 145	......	......	36 45 17. 8	−1 49. 1	+1. 2	....	36 43 29. 9
	8250	15. 450	......	......					
	8273	12. 165	31	8	36 39 59. 3	+3 30. 4	+1. 4	....	31. 1
	8331	17. 360	10	29					
	8344	12. 360	22	17	36 39 40. 7	+3 53. 1	−0. 2	....	33. 6
	8366	16. 390	17	22. 5					
	8370	20. 130	......	......					
October 12, 1878	6674	15. 483	16	21	36 42 48. 4	+0 42. 2	+1. 4	....	32. 0
	6717	14. 440	23	14					
	6728	10. 765	18	19. 5	36 39 32. 2	+3 58. 3	+1. 6	....	32. 1
	6740	16. 650	22	16					
	*a*6784	10. 242	......	......	36 52 23. 1	−8 50. 9	−0. 9	....	31. 3
	6800	24. 100	18	19	36 35 33. 9	+7 58. 9	−0. 9	....	31. 9
	6817	23. 350	18	19. 5					
	6957	12. 275	......	......					
	6928	12. 430	24	14	36 41 8. 4	+2 24. 1	+1. 6	....	34. 1
	6933	15. 988	16. 5	22					
	*b*6944	17. 445	......	......	36 44 2. 8	−0 32. 0	+1. 3	....	32. 1
	6983	17. 235	......	......					
	(*)	23. 060	......	......					
	7041	4. 980	21	17. 5	36 48 49. 1	−5 19. 8	+2. 0	....	31. 3
	7100	30. 330	20	18					
	7131	10. 885	......	......					
	7132	8. 630	......	......					
	7164	20. 405	......	......	36 35 3. 5	+8 27. 7	+1. 5	....	32. 7
	7174	7. 870	......	......					
	7204	6. 593	15	23. 5	36 53 1. 7	−9 32. 9	+2. 2	....	31. 0
	7260	20. 738	26. 5	12					
	7313	8. 330	20	18. 5	36 42 52. 0	+ 39. 8	+0. 5	....	32. 3
	7399	9. 312	19. 5	19. 5					
	7411	*c*− 1. 835	......	......	36 22 49. 3	+20 39. 7	+1. 7	....	30. 7
	7437	29. 445	......	......					
	7461	22. 715	15	24	36 32 53. 8	+10 35. 2	+2. 7	....	31. 7
	7480	7. 030	27. 5	11					
	7520	24. 945	15	24	36 33 6. 5	+10 24. 5	+1. 8	....	32. 8
	7555	9. 525	26	12					
	7571	11. 200	16	23. 5	36 59 23. 5	−15 54. 5	+1. 4	....	30. 4
	7598	28. 820	16. 5	13					
	7627	*d*− 2. 305	......	......					
	......	25. 948	17	22. 5					
	7676	4. 655	25	14					
	7707	11. 385	23. 5	15. 5					
	......	21. 018	17	22					
	7789	22. 313	21	19	36 54 0. 1	−10 34. 6	+2. 7	....	28. 2
	7796	6. 645	22. 5	17					
	7902	7. 245	24. 5	15. 5	36 34 50. 9	+ 8 41. 4	+0. 5	....	32. 8
	7908	20. 120	16	23. 5					
	7967	19. 510	23. 5	16. 5	36 52 13. 3	− 8 44. 1	+0. 4	....	29. 6
	7988	6. 570	17	23					
	8034	16. 373	16	24. 5	36 39 47. 6	+ 3 42. 9	+0. 7	....	36 43 31. 2
	8054	10. 870	25. 5	15					

a Paired thus, 6784, 6817; 6800, 6857. *b* Difference of readings should be 0^r.790, not 0^r.210.

* This star may be Gr. 3157, 1^r in error; omitted.

c Read − 2^r + .835. *d* Should read − 1^r + .305.

Observations and computations for latitude, Fresno, Cal.—Continued.

Date.	Number of star.	Micrometer readings.	Level.		Half sum of declination.	Corrections.			Latitude.
			N.	S.		Micr. and refr.	Level.	Merid.	
					° ′ ″	′ ″	″		° ′ ″
October 12, 1878	......	14.132	......	......	36 43 22.4	+ 0 8.4	+1.6	....	36 43 32.4
	8083	13.925	......	......					
	8138	12.198	24	16	36 49 29.0	− 6 2.7	+2.1	....	28.4
	8149	22.955	18	22.5	36 38 15.2	+ 5 14.5	+2.1	....	31.8
	8162	15.190	25	15					
	8182	3.242	19	21					
	8206	18.992	17.5	23	36 37 51.5	+ 5 37.2	+1.8	....	30.5
	8229	10.665	25.5	15					
	......	17.490	......	......	36 45 18.3	− 1 48.7	+2.6	....	32.2
	8250	14.805	......	......					
	[a]8273	10.970	23	18	36 39 59.8	+ 3 27.0	+3.6	....	30.4
	8331	17.080	23	18					
	8344	12.670	23.5	17	36 39 41.3	+ 3 48.0	+3.6	....	32.9
	8366	16.745	......	......					
	8370	20.338	......	......					
October 13, 1878	6720	22.535	......	......	36 43 12.2	+ 0 19.2	0.0	....	31.4
	6728	11.635	23	16					
	6740	17.560	16	23					
	[b]6784	10.130	......	......	36 52 23.1	− 8 51.6	−1.3	....	30.2
	6800	24.998	14	25	36 35 33.9	+ 7 59.6	−1.3	....	32.2
	6817	24.255	23.5	16					
	6857	13.155	......	......					
	......	19.698	......	......	36 46 39.9	− 3 9.7	−0.3	....	29.9
	6868	15.015	......	......					
	6928	13.085	23	17	36 41 8.5	+ 2 23.5	+0.5	....	32.5
	6933	16.628	15.5	24					
	6944	19.190	17	23	36 44 2.9	− 0 28.8	−0.5	....	33.6
	6983	19.900	22	17.5					
	7041	5.548	......	......					
	7100	30.940	21.5	19	36 48 40.2	− 5 16.2	−0.5	....	32.5
	7131	9.345	18	22					
	7132	11.530	......	......					
	7164	21.405	......	......	36 35 3.6	+ 8 29.1	0.0	....	32.7
	7174	8.835	......	......					
	7204	7.730	19	21	36 53 1.8	− 9 32.9	+0.5	....	29.4
	7260	21.875	22	18.5					
	7313	8.823	21.5	19.5	36 42 52.1	+ 0 38.4	+0.2	....	30.7
	7399	9.772	19.5	21					
	7411	[c]− .795	23	18	36 22 49.5	+20 44.8	−2.2	....	32.1
	7437	30.530	15	26					
	7461	24.393	17.5	23.5	36 32 54.0	+10 36.4	+0.7	....	31.1
	7480	8.680	24.5	16.5					
	7520	25.435	14	27.5	36 33 6.7	+10 21.5	+2.0	....	30.2
	[d]7555	10.090	11	30					
	7571	12.165	17.5	24	36 59 23.6	−15 54.9	+2.3	....	36 43 31.0
	7598	29.810	27	14					
	[e]7627	− .300	......	......					
	......	27.455	14	28					
	7676	6.255	10	32					
	7699	26.468	26	16					
	7707	11.515	19.5	22.5					
	......	21.123	......	......					

[a] Difference 1^{r} too large.

[b] 6784 should read $11^{r}.130$.

[c] Reading − 1^{r} + 0.795.

[d] I assume that the level reading for 7555 = 30 N. 11 S.

[e] 7627 should read $0^{r}.300$.

Observations and computations for latitude, Fresno, Cal.—Continued.

Date.	Number of star.	Micrometer readings.	Level.		Half sum of declination.	Corrections.			Latitude.
			N.	S.		Micr. and refr.	Level.	Merid.	
					° ′ ″	′ ″	″		° ′ ″
October 13, 1878	a7789 7796	22.060 7.410	27 17.5	15 26.5	36 54 0.3	−10 33.8	+1.1	....	36 43 27.6
	7833 7837	21.765 3.233	....	....	36 30 59.5	+12 30.5	+1.8	....	31.8
	7902 7908	8.240 21.010	26.5 19	16.5 24	36 34 51.1	+ 8 37.2	+1.8	....	30.1
	7967 7988	20.390 7.435	26.5 19	16 24	36 52 13.4	− 8 44.7	+2.0	....	30.7
	8634 8054	16.628 11.210	22 24.5	21 18.5	36 39 47.7	+ 3 39.4	+2.5	....	29.6
	...... b8083	14.549 14.405	16.5 13	27 28	36 43 22.6	+ 5.9	+1.6	....	36 43 30.1

a Difference should be 15r.65.
b I have assumed that the level reading of 8083 was 28 N. 13 S.

Discussion of latitude, Fresno.

Combination.	Number observations.	Number stars.	Latitude.	Corrected to micrometer.	Dates excluded.	Combination.	Number observations.	Number stars.	Latitude.	Corrected to micrometer.
			° ′ ″	″					° ′ ″	″
1........	1	3	36 43 32.2	−0.79	....	16	4	3	(*)	....
2........	3	2	32.60	+0.06	....	17	4	2	(*)	....
3........	4	3	31.95	−0.21	....	18	2	2	36 43 27.90	+0.95
4a	4	2	30.50	+0.80	....	19	1	2	30.50	+0.56
4b	4	2	32.32	−0.71	....	20	2	2	30.25	−1.13
5........	1	2	29.9	+0.28	....	21	4	2	33.28	−0.78
6	3	2	32.27	−0.21	....	22	4	2	29.85	+0.78
7........	3	2	32.70	+0.05	....	23	4	2	31.95	−0.34
8.......	3	4	31.60	+0.48	....	24	4	2	31.28	−0.01
9........	4	2	32.42	−0.76	....	25	2	2	27.7	+0.54
10.......	4	2	29.62	+0.86	....	26	2	2	34.3	−0.48
11.......	4	2	31.12	−0.05	....	27	3	2	31.03	−0.50
12.......	3	2	30.77	−1.86	....	28	3	2	31.07	+0.16
13.......	4	2	32.02	−0.96	....	29	3	2	30.97	−0.32
14.......	3	2	31.17	−0.94	....	30	3	3	32.80	−0.35
15.......	3	3	30.43	+1.43	Oct. 3					

Resulting latitude: 36° 43′ 31″.22±0″.15.

* Two stars, of which no accurate places can be found, belong to these combinations; hence there is no result from them till the stars are observed.

ASTRONOMICAL STATION AT FORT BLISS (EL PASO), TEXAS.

GEOGRAPHICAL POSITION OF STATION.

Longitude 106° 29′ 05″.37.
Latitude 31° 45′ 31″.14.
Barometric alt. of observatory above sea-level (top of monument, which is 3 feet high) 3,630.

The monument is situated in the public square of the village of El Paso, 25 feet northwest from its center, measured on a line parallel to the streets. The square is 250 feet on a side, and bounded on the southeast by Saint Louis street, on the northwest by Main and southwest and northeast by Oregon and Utah streets. The street are 70 feet wide. The square is mostly built up on the southwest and southeast side has one house on the northwest side, and to the northeast is open to and forms part o the plain in its original wildness, thinly covered with mesquite, cactus and the like The monument is of brick 18 by 20 inches; 28 inches above ground, on a brick foundation 3¼ feet deep and 6 feet square at the base.

The village of El Paso (of which Franklin is an obsolete name) is situated on th north or left side of the Rio Grande, 1¼ miles from it at present, and opposite to th Mexican town of El Paso del Norte, and 2 miles from it. It does not contain over 30 inhabitants now. It was larger when it was an overland stage station in the earl California emigration. It looks forward to a future in the Southern Pacific and th Chihuahua Railroads. The river flows closely to the Mexican town at present, bu when the international boundary was located in its channel in 1851 it flowed onl half a mile south of the Texan village, having shifted its bed since fully a mile southward, and in doing so destroyed valuable vineyards and the best part of the Mexica town.

The village is also, for the time being, designated Fort Bliss, because the troop assigned to that post are quartered in the village, while the post itself has no corpo real but only an official existence. Its first habitat was 2¼ miles northeast of the village on the river flat, but as the river encroached and threatened its destruction another post was built half a mile eastward on a terrace or raised plain, a few fee above the river bottom. When subsequently the post was abandoned, the groun being private property, the buildings were left unguarded and are now mostly in ruin On the re-establishment of the post a few years ago, the government rented quarte in the village until Congress should authorize the building of a new post, which it ha done since the occupation of the station, and the new post will probably be west o the village.

Colonel Graham, United States Topographical Engineers, made the barometric a titude of Frontera 3,870 feet in 1851. Frontera (a ranch now in ruins) is some 15 mile up the river, and about 250 feet higher than El Paso, as determined by our aneroi barometer readings. This would make his altitude for El Paso 3,620 feet. The locall accepted altitude of the place is between 3,800 and 3,900 feet, which is probably misappropriation of Colonel Graham's altitude for Frontera.

PHYSICAL GEOGRAPHY DETAILS.

The Rio Grande here changes its course from the north, and by a semicircular swee 15 miles in diameter, it passes around the bold south end of the Franklin Ridge c Mountains until by a reverse curve it turns eastward at the old site of Fort Bliss. I passes through a longitudinal depression between the overlapping ends of the Franklin Mountains, east of the river, and the El Paso Mountains west of it, which exten from the conical Rodadero Peak near the boundary monument southward into Mexic This depression is occupied by much eroded and decaying granite-like rock, whic crops out in the river bed producing a rapid, and forms hills 200 to 600 feet hig increasing in height for 6 miles to the flank of the main Franklin Ridge. It is a the foot of the southeasternmost of these granite hills below the rapids, and due sout of the Franklin Mountains, that the village of El Paso is situated.

The mountains on either side of the river are fringed by the remains of a mes about 360 feet above the river and apparently on the same level, and doubtless co tinuous across, before the granite hills were eroded or the country elevated to i present altitude, and before the many beautiful valleys for some 200 miles up the rive where the numerous ancient Indian as well as the later Spanish ruins are now all tha remain, were drained and desiccated. That the elevation of the continental backbon and the further desiccation of the whole Rio Grande Valley, is still in progress is ind cated by recent lava outflows like that of the Mal Pais, by hot springs, and the les degree of desiccation existing only three hundred years ago when the Spaniards mad settlements and had irrigating ditches where there is no water now within long distances.

The river is always yellow, with much impalpably fine sediment. It changes its be often, even in a night, so that fording is always dangerous, and at places changes it course for several miles. Thus, had it not been for the Gadsden purchase the Mexica town of Mesilla would have become American, the river changing from east to wes of that town and two miles beyond. At El Paso, where it is now the internationa boundary, it changed since 1850 a mile to the south. It is a vexed question where th boundary is, whether it remains fixed in the channel, as it was when the survey wa made, or follows the changes. The question arises every time the customs officers o either country pursue smugglers. It also puts in question the ownership of large slic of valuable land as the changing river leaves it on one side or the other. Parties see to claim the old channel or the new to be the boundary whichever is to their advantag

METEOROLOGICAL CONDITIONS.

The rainfall is deficient, and cultivation is possible only as far away from the river as the irrigating ditches can be carried. The traditional rainy season is usually expected during June and July, but according to the experience of present residents, during the last few years the heaviest rains have occurred during July, August, and September, particularly the last two months. During my occupancy of this station, beginning August 6, 1878, there was an almost uninterrupted state of atmospheric disturbance, being cloudy all the time, often overcast, with occasional rains, and a few heavy rainfalls and high winds until September 11, when there was a sudden and remarkable change to a perfectly clear sky, light winds and serene weather, which lasted until my departure, on September 18, except a few cirro-cumuli clouds on the 17th. During the period of bad weather, hardly a day passed without a heavy storm somewhere between El Paso and Pueblo, Colorado, in the Rio Grande Valley, or along the mountains east of it, and telegraphic connection with Ogden for longitude work was prevented for a whole month.

Rain fell on August 10, 12, 16, 19, 22, 23, 28, and 29, and September 4, 6, and 10. On August 28, there was a so-called cloud-burst, and about two inches of rain fell in two hours, flooding the streets with a roaring torrent. During the period of clouds and light rains the wind blew exclusively from the eastern quarters from 2 to 12 miles an hour, with daily intervals of calm. On August 26, the wind shifted to the western quarters, blew 25 miles an hour, and again 20 on the 28th, when the cloud-burst happened. After this the wind blew mostly from the eastern quarters again until September 11, with occasional velocities from 10 to 23 miles an hour, with calms on but three or four days. From September 11 the weather was clear and settled, with light winds from east and west with frequent calms. On eight days there were thunder gusts and heat-lightning with easterly winds. The heavy rains came with westerly winds. In the case of both the thunder-storms from northeast and the heavy rains from the southwest, the clearing winds veered from those quarters towards the right.

The night minimum temperatures until September 10 ranged from 69° to 76°, the day maximum temperatures from 80° to 95°; after September 10, 58° to 64° and 76° to 86° respectively.

The hourly barometric readings from August 10 to 30 afford the following horary curve:

Hours.	Correction to barometer reading.	Hours.	Correction to barometer reading.
7 a. m	— 0.041	7 p. m	+ 0.039
8 "	— 0.046	8 "	+ 0.018
9 "	— 0.044	9 "	— 0.006
10 "	— 0.042	10 "	— 0.015
11 "	— 0.025	11 "	— 0.016
12 m	— 0.004	12 "	— 0.018
1 p. m	+ 0.013	1 a. m	— 0.015
2 "	+ 0.034	2 "	— 0.014
3 "	+ 0.048	3 "	— 0.007
4 "	+ 0.066	4 "	— 0.013
5 "	+ 0.071	5 "	— 0.021
6 "	+ 0.061	6 "	— 0.033

PERSONNEL.—OBSERVATORY.—TELEGRAPH LINES.

The astronomical observer was Miles Rock, C. E., civilian assistant engineer, and the meteorological observer and assistant, Fred. W. Floyd, E. M.; S. W. McMaster was temporarily employed to assist in the hourly meteorological readings, and proved very capable.

The observatory was a wall tent, 9 feet square, with the middle seam of the roof ripped, and fastened apart for a meridian opening.

The United States Military Telegraph and the Western Union lines were used; the former from El Paso to Santa Fé, in the circuit *via* Denver, and from El Paso to Mesilla; thence to San Diego in the circuit *via* California; the latter from Santa Fé and San Diego respectively to Ogden, Utah.

DESCRIPTION OF INSTRUMENTS USED.

The instruments were the same as those used at the Fort Bayard station, and for details see the accompanying report on that station. The transit was by Würdemann, No. 28; Hutton mean time chronometer, No. 288; and Negus break-circuit sidereal chronometer, No. 1344. All the observations were made by the eye and ear method. The mean-time chronometer was carried to the telegraph office for exchange of signals, a distance of 725 feet.

POINTS WITH WHICH CONNECTIONS WERE MADE, ETC.

Robert Reeder, of the United States Signal Corps, was the telegraph ope
circuits were used in making connection with the United States Engineer Ob
Ogden, Utah. The first, *via* San Diego, Cal., was used on September 7
El Paso to Mesilla, 50 miles; thence to Fort Bayard, 100, and beyond ide
same as in the signals from Fort Bayard. The total length of the circui
2,300 miles. The other circuit *via* Santa Fé, N. Mex., was made on Septe
12; from El Paso to Mesilla, 50 miles, and thence the same as in the signa
Bayard station. The total length of the circuit was about 1,400 miles.

On some evenings there was much trouble to effect communication, owing
line, bad weather, and other causes, but finally the success was complete.

The battery power used, as far as I could learn, was as follows: El P
Mesilla, 14 cells. This is not a relay station, but El Paso is connected w
Diego or Santa Fé line as required by a switch; Santa Fé, 70 cells; Sil
cells.

The observations at Fort Bliss have been computed and arranged as
Prof. T. H. Safford:

Tabulation of stars used for determination of time at Ogden, Utah, and Fort

Name of star.		Ogden.					Fort B		
		September 7.	September 8.	September 10.	September 11.	September 12.	September 7.	September 8.	September 10.
ξ	Herculis				×				
o	Herculis				×	×			
A	Herculis				×	×			
κ	Lyræ	×			×				
109	Herculis	×	×						
χ	Draconis	×		×	×	×			
9	Heis Lyræ	×		×		×			
11	Heis Lyræ	×	×						
	Groom. 2655	×	×		×	×			
110	Herculis		×	×		×			
β	Lyræ			×	×				
δ¹	Lyræ				×				
50	Draconis	×		×		×			
γ	Lyræ			×	×				
ζ	Aquilæ	×	×		×	×			
ι	Lyræ	×	×			×			
19	Lyræ	×	×			×			
θ	Lyræ	×				×			
δ	Draconis		×		×				
τ	Draconis	×	×	×		×			
4	Cygni		×	×					
β	Cygni			×					
9	Cygni			×					
φ	Cygni			×					
δ	Cygni						×		
ε	Draconis			×			×		
γ	Sagittæ						×		
τ	Aquilæ						×		
θ	Aquilæ						×		
γ	Cygni						×	×	×
π	Capricorni						×		
ε	Delphini						×	×	×
	Groombr. 3241							×	×
α	Delphini							×	×
α	Cygni							×	×
ε	Cygni							×	×
μ	Aquarii							×	×
ν	Cygni							×	
	Br. 2749							×	×
ς²	Ursæ Majoris, S. P							×	
61	Cygni								×
ζ	Cygni							×	×
	Br. 2777								
τ	Cygni								
11	Cephei		×						
16	Pegasi		×		×	×			
17	Pegasi		×		×	×			
20	Pegasi		×		×	×			

Tabulation of stars used for determination of time, &c.—Continued.

Name of star.	Ogden.					Fort Bliss.				
	September 7.	September 8.	September 10.	September 11.	September 12.	September 7.	September 8.	September 10.	September 11.	September 12.
α Aquarii									×	
ι Pegasi			×							
27 Pegasi		×		×	×					
π Pegasi									×	
24 Cephei		×	×	×	×				×	
Aquarii							×	×	×	
γ Aquarii							×	×	×	
31 Pegasi			×		×					
π Aquarii							×	×	×	
P. xxii. 113					×					
33 Pegasi		×	×		×					
9 H. Draconis, S. P							×	×	×	×
30 Pegasi	×									
7 Lacertæ								×	×	×
Groom. 3804		×								
228 Cephei B							×	×	×	×
31 Cephei	×	×		×	×					
10 Lacertæ									×	×
ξ Pegasi							×		×	
η Pegasi	×	×	×	×						
λ Pegasi	×	×		×	×		×	×		×
ι Cephei	×		×	×	×		×			×
λ Aquarii								×		
Br. 1508, S. P							×			×
o Andromedæ							×			×
β Pegasi			×							
α Pegasi							×			×
π Cephei	×		×							
120 Heis Pegasi	×									
o Cephei	×					×		×	×	
τ Pegasi						×				
υ Pegasi	×									
λ Piscium								×	×	
70 Pegasi	×									
72 Pegasi	×									
λ Andromedæ						×				
ι Piscium						×			×	
Groombr. 4163						×				
ω Piscium						×			×	×
α Andromedæ						×				
γ Pegasi						×				
Cassiopeiæ										×
δ Piscium										×
32 H. Camelopard., S. P										×
ε Piscium										×

Fort Bliss, September 7, 1878; before signals.

Name of star.	Clamp.	T.			Bb.	Aa.	Cc.	T'.			A. R.			ΔT.	
		h.	m.	s.	s.	s.	s.	h.	m.	s.	h.	m.	s.		s.
δ Cygni	E.	19	42	36.63	+ 0.13	− 0.15	+ 0.28	19	43	36.89	19	41	12.50	− 1	24.39
ε Draconis	E.		50	0.33	+ 0.22	− 0.83	+ 0.58		50	0.30		48	36.49	1	23.81
γ Sagittæ	E.		54	46.58	− 0.03	+ 0.11	+ 0.21		54	46.87		53	23.28	(1	23.59)
τ Aquilæ	E.	19	59	38.40	− 0.03	+ 0.20	+ 0.20	19	59	38.77	19	58	14.49	1	24.28
θ Aquilæ	E.	20	6	27.99	− 0.03	+ 0.25	+ 0.20	20	6	28.41	20	5	4.43	1	23.98
γ Cygni	W.		10	18.82	− 0.06	− 0.08	− 0.26		19	18.42		17	54.13	1	24.29
π Capricorni	W.		21	48.50	− 0.03	+ 0.38	− 0.21		21	48.64		20	24.63	1	24.01
ε Delphini	W.	20	28	50.92	− 0.05	+ 0.17	− 0.20	20	28	50.84	20	27	26.75	− 1	24.09

NORMAL EQUATIONS.

$a_0 = +0^s.60 \qquad c_0 = +0^s.25 \qquad \Delta T_0 = -1^m\ 24^s.16$ for $20^h.0$

$$
\begin{array}{l}
\quad\ \ s. \\
0 = +0.076 + 5.66d\Delta T + 1.09da + 1.51dc \\
0 = +0.195 + 1.09d\Delta T + 2.54da - 2.42dc \\
0 = +0.132 + 1.51d\Delta T - 2.42da + 9.74dc
\end{array}
$$

$$
\begin{array}{rlrl}
 & s. & & m.\quad s. \\
d\Delta T = & +0.027 & \Delta T = & -1\ \ 24.133\ (\text{wt.} = 4.33) \\
da = & -0.138 & a = & +\ \ 0.462\ (\text{wt.} = 1.54) \\
dc = & -0.052 & c = & +\ \ 0.198\ (\text{wt.} = 6.18)
\end{array}
$$

Name of star.	Clamp.	T.			Bb.	Aa.	Cc.	T′.			A. R.			Δ T.	
		h.	m.	s.	s.	s.	s.	h.	m.	s.	h.	m.	s.	m.	s.
o Cephei	W.	23	15	7.99	− 0.16	− 0.95	− 0.55	23	15	6.33	23	13	41.76	− 1	24.57
τ Pegasi	W.		16	4.32	− 0.08	+ 0.10	− 0.23		16	4.11		14	39.98	1	24.13
λ Andromedæ	W.		33	5.05	− 0.10	− 0.22	− 0.30		33	4.43		31	39.95	1	24.48
ι Piscium	W.		35	9.11	− 0.07	+ 0.28	− 0.21		35	9.11		33	44.67	1	24.44
Groombr. 4163	E.		50	25.67	− 0.19	− 1.49	+ 0.75		50	24.74		49	0.33	1	24.41
ω Piscium	E.	23	54	31.11	− 0.06	+ 0.27	+ 0.21	23	54	31.53	23	53	6.91	1	24.62
α Andromedæ	E.	0	3	33.06	− 0.08	+ 0.04	+ 0.24	0	3	33.26	0	2	9.09	1	24.17
γ Pegasi	E.	0	8	25.58	− 0.07	+ 0.19	+ 0.22	0	8	25.92	0	7	1.34	− 1	24.58

NORMAL EQUATIONS.

$a_0 = +\ 0^s.60 \qquad c_0 = +\ 0^s.25 \qquad \Delta T_0 = -\ 1^m.24^s.44 \qquad \text{for } 23^h.7$

$$0 = -\ 0.050 + 5.71\, d\,\Delta T - 0.19\, d\,a + 0.38\, d\,c$$
$$0 = -\ 0.078 - 0.19\, d\,\Delta T + 2.89\, d\,a - 0.27\, d\,c$$
$$0 = +\ 0.490 + 0.38\, d\,\Delta T - 0.27\, d\,a + 12.19\, d\,c$$

$$\begin{array}{rlrl} & \text{s.} & \text{m.} & \text{s} \\ d\,\Delta T = & +\ 0.012 & \Delta T = -\ 1 & 24.428\ (\text{wt.} = 5.69) \\ d\,a = & +\ 0.024 & a = + & 0.624\ (\text{wt.} = 2.88) \\ d\,c = & -\ 0.040 & c = + & 0.210\ (\text{wt.} = 12.14) \end{array}$$

Fort Bliss, September 8, 1878; before signals.

Name of star.	Clamp.	T.			B*b*.	A*a*.	C*c*.	T′.			A. R.			Δ T.	
		h.	*m.*	*s.*	*s.*	*s.*	*s.*	*h.*	*m.*	*s.*	*h.*	*m.*	*s.*	*m.*	*s.*
γ Cygni	E.	20	19	18.66	0.00	− 0.07	+ 0.22	20	19	18.81	20	17	54.12	− 1	24.69
ε Delphini	E.		28	51.21	0.00	+ 0.14	+ 0.17		28	51.52	20	27	26.74		24.78
Groombr. 3241 S. P	E.		31	59.23	+ 0.01	− 0.81	+ 0.56		31	58.99	20	30	33.66		25.33
α Delphini	E.		35	26.24	0.00	+ 0.12	+ 0.18		35	26.54	20	34	1.90		24.64
α Cygni	E.		38	44.26	0.00	− 0.12	+ 0.24		38	44.38	20	37	19.53		24.85
ε Cygni	W.		42	45.08	+ 0.04	− 0.01	− 0.21		42	44.90	20	41	19.88		25.02
μ Aquarii	W.		47	33.42	+ 0.03	+ 0.26	− 0.17		47	33.54	20	46	8.57		24.97
ν Cygni	W.		54	5.99	+ 0.14	− 0.08	− 0.23		54	5.82	20	52	40.81		25.01
Bradl. 2749	W.	20	54	33.54	− 0.03	− 1.66	− 0.99	20	54	30.86	20	53	6.23		24.63
σ² Ursæ Maj. S. P	W.	21	1	4.91	− 0.01	+ 0.99	+ 0.45	21	1	6.34	20	50	41.19		25.15
ζ Cygni	W.	21	9	13.09	+ 0.04	+ 0.02	− 0.20	21	9	12.95	21	7	48.18	− 1	24.77

NORMAL EQUATIONS.

$a_0 = +\ 0^s.50 \quad c_0 = +\ 0^s.15 \quad \Delta T_0 = -\ 1^m\ 24^s.84 \quad \text{for } 20^h.7$

$$\begin{aligned} &\quad\ \ s. \\ 0 &= +\ 0.281 + 7.98\, d\ \Delta T + 0.54\, d\, a + 1.25\, d\, c \\ 0 &= +\ 0.701 + 0.54\, d\ \Delta T + 6.21\, d\, a + 2.20\, d\, c \\ 0 &= +\ 0.091 + 1.25\, d\ \Delta T + 2.20\, d\, a + 18.86\, d\, c \end{aligned}$$

$$\begin{aligned} & \quad\ \ s. & & \quad\ \ m.\ \ s. \\ d\,\Delta T &= -\ 0.030 & \Delta T &= -\ 1\ \ 24.870\ (\text{wt.} = 7.87) \\ d\,a &= -\ 0.118 & a &= +\ \ 0.382\ (\text{wt.} = 5.93) \\ d\,c &= +\ 0.021 & c &= +\ \ 0.171\ (\text{wt.} = 17.13) \end{aligned}$$

Fort Bliss, September 10, 1878; after signals.

Name of star.	Clamp.	T.			B b.	A a.	C c.	T′.			AR.			Δ T.	
		h.	*m.*	*s.*	*s.*	*s.*	*s.*	*h.*	*m.*	*s.*	*h.*	*m.*	*s.*	*m.*	*s.*
θ Aquarii	E.	22	11	54.08	− 0.21	+ 0.63	+ 0.11	22	11	54.61	22	10	28.05	− 1	26.56
γ Aquarii	E.		16	51.60	− 0.23	+ 0.54	+ 0.11		16	52.02	22	15	25.46	1	26.56
π Aquarii	E.		20	33.07	− 0.24	+ 0.51	+ 0.11		20	33.45	22	19	06.95	1	26.50
9 H. Draconis S. P.	E.		26	05.45	+ 0.36	+ 3.91	− 0.47		26	09.25	22	24	42.17	1	27.08
7 Lacertæ	E.		27	47.45	− 0.40	− 0.46	+ 0.17		27	46.76	22	26	19.83	1	26.93
226 Cephei B.	E.		31	41.67	− 0.80	− 2.71	+ 0.45		31	38.61	22	30	11.96	1	26.65
λ Pegasi	W.		47	09.96	− 0.33	+ 0.16	− 0.12		47	09.67	22	40	43.29	1	26.38
λ Aquarii	W.	22	47	45.63	− 0.24	+ 0.63	− 0.11	22	47	45.91	22	46	19.29	1	26.62
o Cephei	W.	23	15	10.94	− 0.65	− 1.48	− 0.29	23	15	08.52	23	13	41.78	1	26.74
κ Piscium	W.	23	22	11.21	− 0.26	+ 0.50	− 0.11	23	22	11.34	23	20	44.88	− 1	26.46

NORMAL EQUATIONS.

$a_0 = +\,1^s.00 \qquad c_0 = +\,0^s.15 \qquad \Delta\,T_0 = -\,1^m\ 26^s.60 \qquad \text{for } 22^h.7$

$$\begin{aligned}
&\quad\ \ {}^{s.}\\
0 &= -\,0.063 + 7.28\,d\,\Delta\,T + 2.16\,d\,a + 0.13\,dc\\
0 &= +\,0.023 + 2.16\,d\,\Delta\,T + 7.80\,d\,a - 4.23\,dc\\
0 &= +\,0.555 + 0.13\,d\,\Delta\,T - 4.23\,d\,a + 17.74\,dc
\end{aligned}$$

$$\begin{aligned}
& \qquad\ {}^{s.} & & \qquad {}^{m.}\quad {}^{s.}\\
d\,\Delta\,T &= +\,0.018 & \Delta\,T &= -\,1\ \ 26.582\ (\text{wt.} = 6.58)\\
da &= -\,0.028 & a &= +\quad\ 0.972\ (\text{wt.} = 6.14)\\
dc &= -\,0.038 & c &= +\quad\ 0.112\ (\text{wt.} = 15.29)
\end{aligned}$$

Fort Bliss, September 10, 1878; before signals.

Name of star.	Clamp.	T.			B*b*.	A*a*.	C*c*.	'.			AR.			ΔT.	
		h.	*m.*	*s.*	*s.*	*s.*	*s.*	*h.*	*m.*	*s.*	*h.*	*m.*	*s.*	*m.*	*s.*
γ Cygni	....	20	19	21.08	− 0.27	− 0.20	− 0.07	20	19	20.54	20	17	54.08	− 1	26.46
ε Delphini	....		28	52.85	− 0.20	+ 0.40	− 0.05		28	53.00	20	27	26.72	1	26.28
Groombr. 3241	....		32	03.18	− 0.51	− 2.34	− 0.17		32	00.16	20	30	33.56	1	26.60
μ Delphini	....		35	28.22	− 0.21	+ 0.32	− 0.05		35	28.28	20	34	01.88	1	26.40
ε Cygni	....		38	46.82	− 0.28	− 0.36	− 0.07		38	46.11	20	37	19.49	1	26.62
α Cygni	....		42	46.84	− 0.28	− 0.04	+ 0.06		42	46.58	20	41	19.86	1	26.72
α Aquarii	....		47	34.36	− 0.18	+ 0.74	+ 0.05		47	34.97	20	46	08.55	1	26.42
Bradl. 2749	....	20	54	37.55	− 0.90	− 4.83	+ 0.31	20	54	32.13	20	53	06.07	1	26.06
61 Cygni	....	21	02	56.23	− 0.29	− 0.16	+ 0.07	21	02	55.85	21	01	29.30	1	26.55
ζ Cygni	....	21	09	14.78	− 0.27	+ 0.05	+ 0.06	21	09	14.62	21	07	48.17	− 1	26.45

NORMAL EQUATIONS.

$a_0 = +1^s.00 \qquad c_0 = +0^s.15 \qquad \Delta T_0 = -1^m\ 26^s.50 \qquad \text{for } 20^h.7$

$$
\begin{aligned}
&\overset{s.}{} \\
0 &= -0.155 + 7.75\, d\Delta T - 0.32\, da - 0.25\, dc \\
0 &= -0.544 - 0.32\, d\Delta T + 4.36\, da - 0.69\, dc \\
0 &= +1.744 - 0.25\, d\Delta T - 0.69\, da + 17.06\, dc
\end{aligned}
$$

$$
\begin{array}{llll}
 & s. & & m. \quad s. \\
d\Delta T = & +0.021 & \Delta T = - & 1 \ 26.479 \ (\text{wt.} = 7.72) \\
da = & +0.111 & a = + & 1.111 \ (\text{wt.} = 4.32) \\
dc = & -0.097 & c = + & 0.053 \ (\text{wt.} = 16.94)
\end{array}
$$

Fort Bliss, September 10, 1878; after signals.

Name of star.	Clamp.	T.			B*b*.	A*a*.	C*c*.	T′.			AR.			Δ T.	
		h.	*m.*	*s.*	*s.*	*s.*	*s.*	*h.*	*m.*	*s.*	*h.*	*m.*	*s.*	*m.*	*s.*
θ Aquarii	E.	22	11	54.08	− 0.21	+ 0.63	+ 0.11	22	11	54.61	22	10	28.05	− 1	26.56
γ Aquarii	E.		16	51.60	− 0.23	+ 0.54	+ 0.11		16	52.02	22	15	25.46	1	26.56
π Aquarii	E.		20	33.07	− 0.24	+ 0.51	+ 0.11		20	33.45	22	19	06.95	1	26.50
9 H. Draconis S. P	E.		26	05.45	+ 0.36	+ 3.91	− 0.47		26	09.25	22	24	42.17	1	27.08
7 Lacertæ	E.		27	47.45	− 0.40	− 0.46	+ 0.17		27	46.76	22	26	19.83	1	26.93
226 Cephei B	E.		31	41.67	− 0.80	− 2.71	+ 0.45		31	38.61	22	30	11.96	1	26.65
λ Pegasi	W.		47	09.96	− 0.33	+ 0.16	− 0.12		47	09.67	22	40	43.29	1	26.38
λ Aquarii	W.	22	47	45.63	− 0.24	+ 0.63	− 0.11	22	47	45.91	22	46	19.29	1	26.62
ο Cephei	W.	23	15	10.94	− 0.65	− 1.48	− 0.29	23	15	08.52	23	13	41.78	1	26.74
κ Piscium	W.	23	22	11.21	− 0.26	+ 0.50	− 0.11	23	22	11.34	23	20	44.88	− 1	26.46

NORMAL EQUATIONS.

$a_0 = +1^s.00 \qquad c_0 = +0^s.15 \qquad \Delta T_0 = -1^m\ 26^s.60 \quad \text{for } 22^h.7$

$$\begin{aligned}
0 &= -\overset{s.}{0}.063 + 7.28\, d\,\Delta T + 2.16\, d\,a + 0.13\, dc \\
0 &= +0.023 + 2.16\, d\,\Delta T + 7.80\, d\,a - 4.23\, dc \\
0 &= +0.555 + 0.13\, d\,\Delta T - 4.23\, d\,a + 17.74\, dc
\end{aligned}$$

$$\begin{aligned}
d\,\Delta T &= +\overset{s.}{0.018} & \Delta T &= -\overset{m.}{1}\ \overset{s.}{26.582}\ (\text{wt.} = 6.58) \\
da &= -0.028 & a &= +\ 0.972\ (\text{wt.} = 6.14) \\
dc &= -0.038 & c &= +\ 0.112\ (\text{wt.} = 15.29)
\end{aligned}$$

Fort Bliss, September 12, 1878; before signals.

Name of star.	Clamp.	T.	B b.	A a.	C c.	T′.	A. R.	Δ T.
		h. m. s.	*s.*	*s.*	*s.*	*h. m. s.*	*h. m. s.*	*m. s.*
Groombr. 3241	W.	20 32 03.58	− 0.12	− 1.49	− 0.82	20 32 01.15	20 30 33.46	− 1 27.69
α Delphini*	W.	35 29.12	− 0.05	+ 0.21	− 0.26	35 29.02	20 34 01.86	1 27.16
α Cygni	W.	38 47.70	− 0.06	− 0.23	− 0.36	38 47.05	20 37 19.46	1 27.59
ε Cygni	W.	42 47.88	− 0.06	− 0.03	− 0.30	42 47.49	20 41 19.83	1 27.66
μ Aquarii	W.	47 35.91	− 0.04	+ 0.47	− 0.26	47 36.08	20 46 08.53	1 27.55
Bradl. 2749	E.	20 54 35.22	− 0.66	− 3.08	+ 1.47	20 54 32.95	20 53 05.90	1 27.05
61 Cygni	E.	21 02 57.00	− 0.22	− 0.10	+ 0.32	21 02 57.00	21 01 29.28	1 27.72
ξ Cygni	E.	09 15.50	− 0.20	+ 0.03	+ 0.29	09 15.62	21 07 48.15	1 27.47
τ Cygni	E.	21 11 26.38	− 0.21	− 0.09	+ 0.32	21 11 26.40	21 09 58.70	− 1 27.70

* NOTE.—It is quite likely (though contradicted by the original note-books) that T should read $20^h\ 35^m\ 29^s.32$. In this case we should have the *known* terms of the three normal equations equal to $-0^s.005 + 0^s.014$, and $-1^s.711$ respectively; and Δ T would become $-1^m\ 27^s.571$, $a + 0^s.694$, $c + 0^s.265$; the observation in question would give $\Delta T - 1^m\ 27^s.34$, agreeing more nearly with the final result. The final probable error for weight = 1 from three observations, now $= \pm\ 0^s.137$ would be diminished to $\pm\ 0^s.101$.

NORMAL EQUATIONS.

$$a_0 = +0^s.65 \qquad c_0 = +0^s.15 \qquad \Delta T_0 = -1^m.\ 27^s.60 \qquad \text{for } 20^h.9$$

$$\begin{aligned} &\quad s. \\ 0 &= -0.201 + 7.00\, d\Delta T - 0.65\, da - 1.52\, dc \\ 0 &= -0.044 - 0.65\, d\Delta T + 4.41\, da - 1.71\, dc \\ 0 &= -1.507 + 4.41\, d\Delta T - 1.71\, da + 16.58\, dc \end{aligned}$$

$$\begin{aligned} d\Delta T &= \overset{s.}{+0.056} & \Delta T &= -\ 1^m\ \overset{s.}{27.544}\ (\text{wt.} = 6.71) \\ da &= +0.058 & a &= +\ 0.708\ (\text{wt.} = 4.14) \\ dc &= +0.102 & c &= +\ 0.252\ (\text{wt.} = 15.41) \end{aligned}$$

Fort Bliss, September 12, 1878; after signals.

Name of star.	Clamp.	T.	B *b*.	A *a*.	C *c*.	T′.	A. R.	Δ T.
		h. m. s.	*s.*	*s.*	*s.*	*h. m. s.*	*h. m. s.*	*m. s.*
9 H. Draconis, S. P	E.	22 26 08.24	+ 0.25	+ 2.54	− 0.75	22 26 10.28	22 24 42.25	− 1 28.03
7 Lacertæ	E.	27 47.96	− 0.28	− 0.30	+ 0.27	27 47.65	22 26 19.82	1 27.83
226 Cephei B	E.	31 41.12	− 0.55	− 1.76	+ 0.71	31 39.52	22 30 11.91	1 27.61
10 Lacertæ	E.	35 19.06	− 0.24	− 0.09	+ 0.22	35 18.95	22 33 51.13	1 27.82
λ Pegasi	W.	42 11.12	− 0.25	+ 0.11	− 0.19	42 10.79	22 40 43.29	1 27.50
ι Cephei	W.	46 54.08	− 0.47	− 0.85	− 0.43	46 52.33	22 45 24.55	1 27.78
Bradl. 1508, S. P	W.	51 32.84	+ 0.40	+ 2.95	+ 0.88	51 37.07	22 50 09.17	1 27.90
o Andromedæ	W.	23 57 50.93	− 0.29	− 0 15	− 0.24	22 57 50.25	22 56 22.56	1 27.69
α Pegasi	W.	23 00 12.98	− 0.22	+ 0.19	− 0.18	23 00 12.77	22 58 45.11	1 27.66
ω Piscium	W.	23 54 34.68	− 0.11	+ 0.27	− 0.18	23 54 34.66	23 53 06.96	1 27.70
21 Cassiopeiæ	W.	0 39 14.27	− 0.05	− 1.58	− 0.65	0 39 11.99	0 37 43.79	1 28.20
δ Piscium	W.	43 53.08	− 0.01	+ 0.27	− 0.18	43 53.16	0 42 25.32	1 27.84
32 Camelp., H. S. P	W.	49 29.24	0.00	+ 5.50	+ 1.70	49 36 44	0 48 08.41	1 28.03
ε Piscium	W.	0 58 08.56	0.00	+ 0.26	− 0.18	0 58 08.64	0 56 40.82	− 1 27.82

NORMAL EQUATIONS.

$a_0 + 0^s.65 \qquad c_0 = +0^s.15 \qquad \Delta T_0 = -1^m\ 27^s.70 \text{ for } 23^h.5$

$$\begin{aligned} &\overset{s.}{} \\ 0 &= +0.620 + 8.82\, d\Delta T + 0.99\, da - 5.22\, dc \\ 0 &= +0.247 + 0.99\, d\Delta T + 15.43\, da + 3.51\, dc \\ 0 &= -1.035 - 5.22\, d\Delta T + 3.51\, da + 32.04\, dc \end{aligned}$$

$$\begin{aligned} d\Delta T &= -\overset{s}{0.052} & \Delta T &= -\overset{m.}{1}\ \overset{s.}{27.752}\ (\text{wt.} = 7.81) \\ da &= -0.019 & a &= +\ 0.631\ (\text{wt.} = 14.74) \\ dc &= +0.026 & c &= +\ 0.176\ (\text{wt.} = 27.85) \end{aligned}$$

Fort Bliss, September 12, 1878; before signals.

Name of star.	Clamp.	T.	B *b*.	A *a*.	C *c*.	T′.	A. R.	Δ T.
		h. m. s.	*s.*	*s.*	*s.*	*h. m. s.*	*h. m. s.*	*m. s.*
Groombr. 3241	W.	20 32 03.58	− 0.12	− 1.49	− 0.82	20 32 01.15	20 30 33.46	− 1 27.69
α Delphini*	W.	35 29.12	− 0.05	+ 0.21	− 0.26	35 29.02	20 34 01.86	1 27.16
α Cygni	W.	38 47.70	− 0.06	− 0.23	− 0.36	38 47.05	20 37 19.46	1 27.59
ε Cygni	W.	42 47.88	− 0.06	− 0.03	− 0.30	42 47.49	20 41 19.83	1 27.66
μ Aquarii	W.	47 35.91	− 0.04	+ 0.47	− 0.26	47 36.08	20 46 08.53	1 27.55
Bradl. 2749	E.	20 54 35.22	− 0.66	− 3.08	+ 1.47	20 54 32.95	20 53 05.90	1 27.05
61 Cygni	E.	21 02 57.00	− 0.22	− 0.10	+ 0.32	21 02 57.00	21 01 29.28	1 27.72
ξ Cygni	E.	09 15.50	− 0.20	+ 0.03	+ 0.29	09 15.62	21 07 48.15	1 27.47
τ Cygni	E.	21 11 26.38	− 0.21	− 0.09	+ 0.32	21 11 26.40	21 09 58.70	− 1 27.70

* NOTE.—It is quite likely (though contradicted by the original note-books) that T should read $20^h\ 35^m\ 29^s.32$. In this case we should have the *known* terms of the three normal equations equal to $-0^s.005+0^s.014$, and $-1^s.711$ respectively; and Δ T would become $-1^m\ 27^s.571$, $a+0^s.694$. $c+0^s.265$; the observation in question would give $\Delta T - 1^m\ 27^s.34$, agreeing more nearly with the final result. The final probable error for weight =1 from three observations, now $= \pm\ 0^s.137$ would be diminished to $\pm\ 0^s.101$.

NORMAL EQUATIONS.

$$a_0 = +0^s.65 \qquad c_0 = +0^s.15 \qquad \Delta T_0 = -1^m.\ 27^s.60 \qquad \text{for } 20^h.9$$

$$\begin{aligned}
&\quad\ \ s.\\
0 &= -0.201 + 7.00\, d\,\Delta T - 0.65\, da - 1.52\, dc\\
0 &= -0.044 - 0.65\, d\,\Delta T + 4.41\, da - 1.71\, dc\\
0 &= -1.507 + 4.41\, d\,\Delta T - 1.71\, da + 16.58\, dc
\end{aligned}$$

$$\begin{aligned}
d\,\Delta T &= +\overset{s.}{0.056} & \Delta T &= -\ 1^m\ \overset{s.}{27.544}\ (\text{wt.} = 6.71)\\
da &= +0.058 & a &= +\ 0.708\ (\text{wt.} = 4.14)\\
dc &= +0.102 & c &= +\ 0.252\ (\text{wt.} = 15.41)
\end{aligned}$$

Ogden, September 7, 1878; after signals.

Name of star.	Clamp.	T.	Bb.	Aa.	Cc.	T'.	RA.	ΔT.
		h. m. s.	s.	s.	s.	h. m. s.	h. m. s.	m. s.
30 Pegasi	E.	22 29 44.90	+ 0.11	− 0.57	+ 0.25	22 29 44.69	22 26 45.69	− 2 59.00
31 Cephei	E.	22 35 44.89	+ 0.33	+ 2.61	+ 0.80	35 48.63	22 32 49.50	2 59.18
η Pegasi	E.	22 40 19.69	+ 0.13	− 0.34	+ 0.27	40 19.75	22 37 20.96	2 58.79
λ Pegasi	E.	22 43 42.32	+ 0.12	− 0.49	+ 0.25	43 42.20	22 40 43.23	2 58.97
ι Cephei	E.	22 48 21.17	+ 0.25	+ 1.44	+ 0.56	22 48 23.42	22 45 24.49	2 58.93
π Cephei	W.	23 07 02.37	+ 0.41	+ 3.03	− 0.88	23 07 04.93	23 04 06.13	2 58.80
130 Heis Pegasi	W.	23 13 00.72	+ 0.13	− 0.47	− 0.26	13 00.12	23 10 01.07	2 59.05
ο Cephei	W.	23 16 39.41	+ 0.30	+ 1.66	− 0.61	16 40.76	23 13 41.77	2 58.99
υ Pegasi	W.	23 22 21.03	+ 0.13	− 0.50	− 0.25	22 20.41	23 19 21.48	2 58.93
70 Pegasi	W.	23 26 02.99	+ 0.11	− 0.72	− 0.24	26 02.14	23 23 03.18	2 58.96
72 Pegasi	W.	23 30 57.55	+ 0.15	− 0.31	− 0.27	23 30 57.12	23 27 58.12	− 2 59.00

NORMAL EQUATIONS.

$$a_0 = -1^s.45 \qquad c_0 = +0^s.22 \qquad \Delta T_0 = -2^m.58^s.98 \text{ for } 23^h.0$$

s.

$$0 = -0.155 + 8.08\, d\Delta T + 0.06\, da - 0{,}90\, dc$$
$$0 = -0.009 + 0.06\, d\Delta T + 3.74\, da - 0.30\, dc$$
$$0 = -0.247 - 0.90\, d\Delta T - 0.30\, da + 20.75\, dc$$

m. s.

$$d\Delta T = +0.021 \quad \Delta T = -2\ 58.950 \ (\text{wt.} = 8.04)$$
$$da = +0.003 \quad a = -1.447 \ (\text{wt.} = 3.74)$$
$$dc = +0.013 \quad c = +0.233 \ (\text{wt.} = 20.63)$$

Ogden, September 7, 1878; before signals.

Name of star.	Clamp.	T.			Bb.	Aa.	Cc.	T'.			A. R.			ΔT.	
		h.	*m.*	*s.*	*s.*	*s.*	*s.*	*h.*	*m.*	*s.*	*h.*	*m.*	*s.*	*m.*	*s.*
κ Lyræ	W.	18	18	35, 95	— 0. 01	+ 0. 04	— 0. 18	18	18	35. 80	18	15	37, 69	— 2	58. 11
109 Herculis	W.	18	21	31. 13	— 0. 01	+ 0. 11	— 0. 15		21	31. 08	18	18	32. 81	2	58. 27
χ Draconis	W.	18	26	14. 81	— 0. 01	— 0. 55	— 0. 48		26	13. 77	18	23	15. 51	2	58. 26
9 Heis Lyræ	W.	18	31	11, 00	— 0. 01	+ 0. 07	— 0. 17		31	10. 89	18	28	12. 73	2	58. 16
11 Heis Lyræ	W.	18	35	09. 66	— 0. 01	+ 0. 05	— 0. 17		35	09. 53	18	32	11. 43	2	58. 10
Gr. 2655	W.	18	38	37. 12	— 0. 02	— 0. 85	— 0. 66		38	35. 59	18	35	37. 37	2	58. 22
50 Draconis	E.	18	53	16. 69	+ 0. 20	— 0. 69	+ 0. 57	18	53	16. 77	18	50	18. 33	2	58. 44
ζ Aquilæ	E.	19	02	49. 38	+ 0. 06	+ 0. 15	+ 0. 15	19	02	49. 74	18	59	51. 42	2	58. 32
ι Lyræ	E.	19	05	57. 45	+ 0. 08	+ 0. 04	+ 0. 18		05	57. 75	19	02	59. 66	2	58. 09
19 Lyræ	E.	19	10	06. 13	+ 0. 07	+ 0. 06	+ 0. 17		10	06. 43	19	07	08. 16	2	58. 27
θ Lyræ	E.	19	15	08. 54	+ 0. 08	+ 0. 02	+ 0. 18		15	08. 82	19	12	10. 75	2	58. 07
τ Draconis	E.	19	20	52. 13	+ 0. 18	— 0. 57	+ 0. 50	19	20	52. 24	19	17	54. 27	— 2	57. 97

NORMAL EQUATIONS.

$a_e = +0^s.33 \qquad c_e = +0^s.14 \qquad \Delta T_e = -2^m\ 58^s.18$ for $19^h\ 0^m$

$$
\begin{aligned}
& \quad s. \\
0 &= -0.010 + 8.87\, d\Delta T - 0.41\, da + 0.08\, dc \\
0 &= +0.073 - 0.41\, d\Delta T + 4.75\, da + 0.18\, dc \\
0 &= -0,083 + 0,08\, d\Delta T + 0.18\, da + 24,15\, dc
\end{aligned}
$$

$$
\begin{aligned}
& \quad s. & & \quad m.\quad s. \\
d\Delta T &\ \ 0.000 & \Delta T &= -2\ 58.180\ (\text{wt.} = 8.83) \\
da &-0.016 & a &= +\ \ 0.314\ (\text{wt.} = 4.73) \\
dc &+0.004 & c &= +\ \ 0.144\ (\text{wt.} = 24.14)
\end{aligned}
$$

Ogden, September 8, 1878; after signals.

Name of star.	Clamp.	T.			B *b*	A *a*	C *c*	T′.			A. R.			Δ T.	
		h.	*m.*	*s.*	*s.*	*s.*	*s.*	*h.*	*m.*	*s.*	*h.*	*m.*	*s.*	*m.*	*s.*
11 Cephei	E.	21	43	10.86	+ 0.45	+ 1.71	+ 0.62	21	43	13.64	21	40	11.15	− 3	2.49
16 Pegasi	E.	21	50	36.83	+ 0.15	− 0.34	+ 0.23		50	36.87	21	47	34.43	3	2.44
17 Pegasi	E.	21	54	06.18	+ 0.12	− 0.58	+ 0.21		54	05.93	21	51	03.44	3	2.49
20 Pegasi	E.	21	58	15.52	+ 0.11	− 0.56	+ 0.21	21	58	15.28	21	55	12.68	3	2.60
27 Pegasi	E.	22	06	55.29	+ 0.12	− 0.20	+ 0.24	22	06	55.45	22	03	53.05	3	2.40
24 Cephei	E.	22	10	30.72	+ 0.27	+ 1.85	+ 0.65		10	33.49	22	07	31.28	3	2.21
33 Pegasi	W.	22	27	33.54	+ 0.02	− 0.22	− 0.24		27	33.10	22	24	30.85	3	2.25
Gr. 3804	W.	22	30	09.30	+ 0.03	− 0.05	− 0.26		30	09.02	22	27	06.63	3	2.39
31 Cephei	W.	22	35	50.81	+ 0.06	+ 2.06	− 0.70		35	52.23	22	32	49.48	3	2.75
η Pegasi	W.	22	40	23.80	+ 0.02	− 0.26	− 0.23		40	23.33	22	37	20.97	3	2.36
λ Pegasi	W.	22	43	46.28	+ 0.02	− 0.39	− 0.22	22	43	45.69	22	40	43.23	− 3	2.46

NORMAL EQUATIONS.

$a_0 = -1^s.10 \qquad c_0 = +0^s.28 \qquad \Delta T_0 = -3^m\,2^s.48 \quad \text{for } 22^h.0$

$$\begin{aligned} & \quad\ \ {}^{s.} \\ 0 &= +0.028 + 8.48\, d\Delta T + 0.64\, da + 0.92\, dc \\ 0 &= +0.113 + 0.64\, d\Delta T + 3.35\, da - 0.80\, dc \\ 0 &= +0.468 + 0.92\, d\Delta T - 0.80\, da + 19.41\, dc \end{aligned}$$

$$\begin{aligned} & & & \quad\ {}^{m.}\ \ {}^{s.} \\ [d\Delta T &= +0.003 & \Delta T &= -3\ \ 2.427\ (\text{wt.} = 8.30) \\ da &= -0.041 & a &= -\ \ 1.141\ (\text{wt.} = 3.26) \\ dc &= -0.026 & c &= +\ \ 0.204\ (\text{wt.} = 19.08) \end{aligned}$$

Ogden, September 8, 1878; before signals.

Name of star.	Clamp.	T.	B*b*.	A*a*.	C*c*.	T′.	A. R.	Δ T.
		h. *m.* *s.*	*s.*	*s.*	*s.*	*h.* *m.* *s.*	*h.* *m.* *s.*	*m.* *s.*
109 Herculis	W.	18 21 35.25	+ 0.05	− 0.39	− 0.26	18 21 34.65	18 18 32.80	− 3 1.85
χ Draconis	W.	18 26 16.86	+ 0.13	+ 1.90	− 0.81	26 17.58	18 23 15.43	3 2.15
9 Heis Lyræ	W.	18 31 15.00	+ 0.05	− 0.24	− 0.28	31 14.53	18 28 12.71	3 1.82
11 Heis Lyræ	W.	18 35 13.76	+ 0.06	− 0.18	− 0.29	35 13.35	18 32 11.41	3 1.94
Gr. 2655	W.	18 38 36.92	+ 0.17	+ 2.96	− 1.11	38 38.94	18 35 37.27	3 1.67
110 Herculis	W.	18 43 30.33	+ 0.05	− 0.41	− 0.26	18 43 29.71	18 40 27.76	3 1.95
ζ Aquilæ	E.	19 02 53.62	+ 0.02	− 0.52	+ 0.25	19 02 53.37	18 59 51.41	3 1.96
ι Lyræ	E.	19 06 01.24	+ 0.02	− 0.12	+ 0.30	06 01.44	19 02 59.63	3 1.81
19 Lyræ	E.	19 10 10.00	+ 0.02	− 0.22	+ 0.28	10 10.08	19 07 08.14	3 1.94
δ Draconis	E.	19 15 32.90	+ 0.05	+ 1.25	+ 0.63	15 34.83	19 12 32.81	3 2.02
τ Draconis	E.	19 20 53.07	+ 0.06	+ 1.98	+ 0.83	20 55.94	19 17 54.20	3 1.74
4 Cygni	E.	19 24 50.03	+ 0.02	− 0.12	+ 0.30	19 24 50.22	19 21 48.81	− 3 1.92

NORMAL EQUATIONS.

$a_0 = -1^s.10 \qquad c_0 - +0^s.23 \qquad \Delta T_0 = -3^m\ 1^s.90$ for $19^h.0$

$$\begin{aligned}
&\quad\ \ s.\\
0 &= +0.027 + 8.66\,d\,\Delta T - 0.08\,da + 0.36\,dc\\
0 &= -0.061 - 0.08\,d\,\Delta T + 4.34\,da + 0.67\,dc\\
0 &= -0.260 + 0.36\,d\,\Delta T + 0.67\,da + 23.18\,dc
\end{aligned}$$

$$\begin{aligned}
& & & \quad\ m.\quad s. \\
d\,\Delta T &= -0.003 & \Delta T &= -3\ \ 1.903\ (\text{wt.} = 8.65)\\
da &= +0.012 & a &= -\ \ \ \ 1.088\ (\text{wt.} = 4.32)\\
dc &= +0.011 & c &= +\ \ \ \ 0.241\ (\text{wt.} = 23.07)
\end{aligned}$$

Name of star.	Clamp.	T.			Bb.	Aa.	Cc.	T'.			A. R.			Δ T.	
		h.	*m.*	*s.*	*s.*	*s.*	*s.*	*h.*	*m.*	*s.*	*h.*	*m.*	*s.*	*m.*	*s.*
ι Pegasi	W.	22	04	25.82	+ 0.20	+ 0.01	− 0.22	22	04	25.81	22	01	23.69	− 3	2.12
24 Cephei	W.	22	10	33.59	+ 0.52	− 0.08	− 0.65		10	33.38	22	07	31.24	3	2.14
31 Pegasi	W.	22	18	37.22	+ 0.17	+ 0.02	− 0.21		18	37.20	22	15	34.75	3	2.45
38 Pegasi	W.	22	27	33.19	+ 0.22	+ 0.01	− 0.24		27	33.18	22	24	30.85	3	2.33
π Pegasi	E.	22	40	22.50	+ 0.29	+ 0.01	+ 0.23		40	23.03	22	37	20.97	3	2.06
λ Pegasi	E.	22	43	44.94	+ 0.26	+ 0.02	+ 0.22		43	45.44	22	40	43.23	3	2.21
ι Cephei	E.	22	48	25.82	+ 0.56	− 0.05	+ 0.49	22	48	26.82	22	45	24.49	3	2.33
β Pegasi	E.	23	00	57.41	+ 0.28	+ 0.01	+ 0.23	23	00	57.93	22	57	55.60	3	2.33
π Cephei	E.	23	07	07.01	+ 0.81	− 0.10	+ 0.77	23	07	08.49	23	04	06.13	− 3	2.36

NORMAL EQUATIONS.

$a_0 = 0.00 \qquad c_0 = +\,0^s.20 \qquad \Delta T_0 = -\ 3^m,\ 2^s.24$ for $22^h.5$

$$\begin{aligned} & \quad\ \ {}^{s.} \\ 0 &= +\,0.106 + 6.72\,d\,\Delta T + 0.26\,da + 1.08\,dc \\ 0 &= -\,0.128 + 0.26\,d\,\Delta T + 2.97\,da - 1.56\,dc \\ 0 &= +\,0.031 + 1.08\,d\,\Delta T - 1.56\,da + 16.57\,dc \end{aligned}$$

$$\begin{aligned} d\,\Delta T &= -\,0.018^{s.} & \Delta T &= -\,3^{m.}\ 2.258^{s.}\ (\text{wt.} = 6.60) \\ da &= +\,0.047 & a &= +\ 0.047\ (\text{wt.} = 2.80) \\ dc &= +\,0.004 & c &= +\ 0.204\ (\text{wt.} = 15.54) \end{aligned}$$

Ogden, September 10, 1878; *before signals.*

Name of star.	Clamp.	T.	Bb.	Aa.	Cc.	T′.	A. R.	ΔT.
		h. m. s.	s.	s.	s.	h. m. s.	h. m. s.	m. s.
χ Draconis	E.	18 26 16.24	+ 0.31	+ 0.37	+ 0.68	18 26 17.60	18 23 15.26	— 3 2.34
9 Heis Lyræ	E.	18 31 14.73	+ 0.12	— 0.04	+ 0.23	31 15.04	18 28 12.67	3 2.37
110 Herculis	E.	18 43 29.79	+ 0.11	— 0.08	+ 0.21	43 30.03	18 40 27.73	3 2.30
β Lyræ	E.	18 48 39.08	+ 0.13	— 0.03	+ 0.24	48 39.42	18 45 37.15	3 2.27
50 Draconis	E.	18 53 18.80	+ 0.36	+ 0.46	+ 0.80	53 20.42	18 50 18.10	3 2.32
γ Lyræ	E.	18 57 27.41	+ 0.13	— 0.04	+ 0.24	18 57 27.74	18 54 25.57	3 2.17
τ Draconis	W.	19 20 56.49	+ 0.25	+ 0.38	— 0.70	19 20 56.42	19 17 54.06	3 2.36
4 Cygni	W.	19 24 50.57	+ 0.11	— 0.02	— 0.25	24 50.41	19 21 48.27	3 2.14
β Cygni	W.	19 28 53.49	+ 0.09	— 0.05	— 0.23	28 53.30	19 25 51.11	3 2.19
ϑ Cygni	W.	19 33 05.53	+ 0.10	— 0.05	— 0.23	33 05.35	19 30 02.99	3 2.36
ϕ Cygni	W.	19 37 39.04	+ 0.10	— 0.05	— 0.23	37 38.86	19 34 36.43	3 2.43
ε Draconis	W.	19 51 38.64	+ 0.22	+ 0.29	— 0.59	19 51 38.56	19 48 36.30	— 3 2.26

NORMAL EQUATIONS.

$$a_0 = -0^s.20 \qquad c_0 = +0^s.20 \qquad \Delta T_0 = -3^m\ 2^s.28 \text{ for } -19^h.0$$

$$\begin{aligned} 0 &= +0^s.012 + 8.60\, d\Delta T - 0.40\, da - 0.17\, dc \\ 0 &= +0.035 - 0.40\, d\Delta T + 4.12\, da - 0.36\, dc \\ 0 &= -0.039 - 0.17\, d\Delta T - 0.36\, da + 23.37\, dc \end{aligned}$$

$$\begin{aligned} d\Delta T &= -0^s.002 \quad & \Delta T &= -3^m\ 2^s.282 \text{ (wt.} = 8.56) \\ da &= -0.009 & a &= -\ 0.209 \text{ (wt.} = 4.10) \\ dc &= -0.002 & c &= +\ 0.202 \text{ (wt.} = 23.34) \end{aligned}$$

after signals.

Name of star.	Clamp.	T.	Bb.	Aa.	Ce.	T'.	A. R.	ΔT.
		h. m. s.	s.	s.	s.	h. m. s.	h. m. s.	m. s.
ι Pegasi	W.	22 04 25.82	+ 0.20	+ 0.01	− 0.22	22 04 25.81	22 01 23.69	− 3 2.12
24 Cephei	W.	22 10 33.59	+ 0.52	− 0.08	− 0.65	10 33.38	22 07 31.24	3 2.14
31 Pegasi	W.	22 18 37.22	+ 0.17	+ 0.02	− 0.21	18 37.20	22 15 34.75	3 2.45
38 Pegasi	W.	22 27 33.19	+ 0.22	+ 0.01	− 0.24	27 33.18	22 24 30.85	3 2.33
η Pegasi	E.	22 40 22.50	+ 0.29	+ 0.01	+ 0.23	40 23.03	22 37 20.97	3 2.06
λ Pegasi	E.	22 43 44.94	+ 0.26	+ 0.02	+ 0.22	43 45.44	22 40 43.23	3 2.21
ι Cephei	E.	22 48 25.82	+ 0.56	− 0.05	+ 0.49	22 48 26.82	22 45 24.49	3 2.33
β Pegasi	E.	23 00 57.41	+ 0.28	+ 0.01	+ 0.23	23 00 57.93	22 57 55.60	3 2.33
π Cephei	E.	23 07 07.01	+ 0.81	− 0.10	+ 0.77	23 07 08.49	23 04 06.13	− 3 2.36

NORMAL EQUATIONS.

$a_0 = 0.00 \qquad c_0 = +\ 0^s.20 \qquad \Delta T_0 = -\ 3^m,\ 2^s.24 \text{ for } 22^h.5$

$$\begin{aligned} &\quad\ \ ^{s.} \\ 0 &= +\ 0.106 + 6.72\, d\,\Delta T + 0.26\, da + 1.08\, dc \\ 0 &= -\ 0.128 + 0.26\, d\,\Delta T + 2.97\, da - 1.56\, dc \\ 0 &= +\ 0.031 + 1.08\, d\,\Delta T - 1.56\, da + 16.57\, dc \end{aligned}$$

$$\begin{aligned} & \qquad\qquad\quad ^{s.} & & \qquad\quad ^{m.} \qquad\qquad\quad ^{s.} \\ d\,\Delta T &= -\ 0.018 & \Delta T &= -\ 3\ [2.258\ (\text{wt.} = 6.60) \\ da &= +\ 0.047 & a &= +\ \ \ 0.047\ (\text{wt.} = 2.80) \\ dc &= +\ 0.004 & c &= +\ \ \ 0.204\ (\text{wt.} = 15.54) \end{aligned}$$

Ogden, September 11, 1878; before signals.

Name of star.	Clamp.	T.	Bb.	Aa.	Cc.	T′.	A.R.	ΔT.
		h. m. s.	*s.*	*s.*	*s.*	*h. m. s.*	*h. m. s.*	*m. s.*
ξ Herculis	E.	17 56 03.17	+0.29	+0.02	+0.19	17 56 03.67	17 53 03.85	−2 59.82
o Herculis	E.	18 05 48.86	+0.29	+0.02	+0.19	18 05 49.36	18 02 49.55	2 59.81
A Herculis	E.	18 10 20.61	+0.30	+0.02	+0.19	10 21.12	18 07 21.26	2 59.86
κ Lyræ	E.	18 18 36.85	+0.82	+0.01	+0.21	18 37.39	18 15 37.60	2 59.79
χ Draconis	E.	18 26 13.58	+0.75	−0.15	+0.55	26 14.73	18 23 15.20	2 59.53
Gr. 2655	W.	18 38 36.93	+0.97	−0.23	−0.76	38 36.91	18 35 36.96	2 59.95
β Lyræ	W.	18 48 37.03	+0.08	+0.01	−0.20	48 36.92	18 45 37.13	2 59.79
δ¹ Lyræ	W.	18 53 16.70	+0.08	+0.01	−0.21	53 16.58	18 50 16.77	2 59.81
γ Lyræ	W.	18 57 25.34	+0.08	+0.02	−0.20	18 57 25.24	18 54 25.56	2 59.68
ζ Aquilæ	W.	19 02 51.42	+0.06	+0.04	−0.17	19 02 51.35	18 59 51.37	2 59.98
δ Draconis	W.	19 15 32.51	+0.16	−0.10	−0.43	19 15 32.14	19 12 32.67	−2 59.47

NORMAL EQUATIONS.

$a_0 = 0.00 \qquad c_0 = +0^s.20 \qquad \Delta T_0 = -2^m\ 59^s.80$ for $19^h\ 0^m$

$$0 = -0.097 + 8.28\, d\Delta T + 0.11\, da - 0.92\, dc$$
$$0 = -0.226 + 0.11\, d\Delta T + 3.24\, da + 1.63\, dc$$
$$0 = +0.562 - 0.92\, d\Delta T + 1.63\, da + 20.09\, dc$$

$$d\Delta T = +0^s.007 \qquad \Delta T = -2^m\ 59^s.793 \text{ (wt.} = 8.23)$$
$$da = +0.087 \qquad a = +0.087 \text{ (wt.} = 3.11)$$
$$dc = 0.035 \qquad c = +0.165 \text{ (wt.} = 19.17)$$

Ogden, September 11, 1878; after signals.

Name of star.	Clamp.	T.	B *b*.	A *a*.	C *c*.	T′.	A. R.	ΔT.
		h. m. s.	*s.*	*s.*	*s.*	*h. m. s.*	*h. m. s.*	*m. s.*
16 Pegasi	W.	21 50 33.82	+ 0.24	— 0.04	— 0.19	21 50 33.83	21 47 34.42	— 2 59.41
17 Pegasi	W.	21 54 03.04	+ 0.20	— 0.06	— 0.17	54 03.01	21 51 03.43	2 59.58
20 Pegasi	W.	21 58 12.46	+ 0.21	— 0.06	— 0.17	21 58 12.44	21 55 12.68	2 59.76
27 Pegasi	W.	22 06 52.44	+ 0.27	— 0.02	— 0.21	22 06 52.48	22 03 53.04	2 59.44
24 Cephei	W.	22 10 30.43	+ 0.63	+ 0.19	— 0.55	10 30.70	22 07 31.22	2 59.48
31 Cephei	E.	22 35 47.64	+ 0.87	+ 0.22	+ 0.59	35 49.32	22 32 49.45	2 59.87
η Pegasi	E.	22 40 19.85	+ 0.34	— 0.03	+ 0.20	40 20.86	22 37 20.97	2 59.89
λ Pegasi	E.	22 43 42.33	+ 0.31	— 0.04	+ 0.19	43 42.79	22 40 43.34	2 59.45
ι Cephei	E.	22 48 22.67	+ 0.63	+ 0.12	+ 0.42	22 48 23.84	22 45 24.48	- 2 59.36

NORMAL EQUATIONS.

$a_0 = 0 \qquad c_0 = +\,0^s.20 \qquad \Delta T_0 = -\,2^m\ 59^s.55 \text{ for } 22^h.5$

$$\begin{aligned} & \quad\ s. \\ 0 &= -\,0.145 + 6.81\,d\Delta T + 0.48\,da - 0.98\,dc \\ 0 &= +\,0.293 + 0.48\,d\Delta T + 3.02\,da - 2.17\,dc \\ 0 &= +\,0.200 - 0.93\,d\Delta T - 2.17\,da + 16.28\,dc \end{aligned}$$

$$\begin{aligned} & \qquad\quad s. & & \qquad\quad m.\quad s. \\ d\Delta T &= +\,0.026 & \Delta T &= -\,2\ \ 59.524\ (\text{wt.} = 6.71) \\ da &= -\,0.120 & a &= -\quad 0.120\ (\text{wt.} = 2.71) \\ dc &= -\,0.027 & c &= +\quad 0.173\ (\text{wt.} = 14.68) \end{aligned}$$

Ogden, September 12, 1873; before signals.

Name of star.	Clamp.	T.	Bb.	Aa.	Ca.	T'.	A. R.	ΔT.
		h. m. s.	s.		s.	h. m. s.	h. m. s.	
o Herculis	E.	18 05 46.82	+ 0.26	− 0.03	+ 0.17	18 05 47.22	18 02 49.53	− 2 57.69
A Herculis	E.	10 18.39	+ 0.27	− 0.02	+ 0.18	10 18.82	18 07 21.24	2 57.58
χ Draconis	E.	26 11.49	+ 0.60	+ 0.20	+ 0.51	26 12.80	18 23 14.94	2 57.86
9 Heis Lyræ	E.	31 09.92	+ 0.18	− 0.02	+ 0.18	31 10.26	18 28 12.63	2 57.63
Groombr. 2655	E.	38 32.57	+ 0.48	+ 0.31	+ 0.70	38 34.06	18 35 36.85	2 57.21
110 Herculis	E.	43 24.88	+ 0.11	− 0.04	+ 0.16	43 25.11	18 40 27.69	2 57.42
50 Draconis	W.	18 53 15.75	+ 0.24	+ 0.25	− 0.60	18 53 15.64	18 50 17.89	2 57.75
ζ Aquilæ	W.	19 02 49.11	+ 0.07	− 0.05	− 0.16	19 02 48.97	18 59 51.34	2 57.63
ι Lyræ	W.	05 57.21	+ 0.09	− 0.01	− 0.19	05 57.10	19 02 59.56	2 57.54
19 Lyræ	W.	10 05.71	+ 0.09	− 0.02	− 0.18	10 05.60	19 07 08.07	2 57.53
θ Lyræ	W.	15 08.36	+ 0.09	− 0.01	− 0.19	15 08.25	19 12 10.65	2 57.60
τ Draconis	W.	19 20 51.45	+ 0.22	− 0.21	− 0.53	19 20 51.35	19 17 53.92	− 2 57.48

NORMAL EQUATIONS.

$a_0 = -0^s.20 \qquad c_0 = +0^s.20 \qquad \Delta T_0 = -2^m\,57^s.58$ for $19^h.0$

$$\begin{aligned} &\ \ s. \\ 0 &= -0.010 + 8.44\,d\Delta T - 0.23\,da - 0.15\,dc \\ 0 &= -0.410 - 0.23\,d\Delta T + 4.88\,da + 0.02\,dc \\ 0 &= +1.121 - 0.15\,d\Delta T + 0.02\,da + 23.96\,dc \end{aligned}$$

$$\begin{aligned} d\Delta T &= +0.003^s & \Delta T &= -2^m\,57^s.577 \ (\text{wt.} = 8.43) \\ da &= +0.085 & a &= -\ 0.115 \ (\text{wt} = 4.82) \\ dc &= -0.047 & c &= +\ 0.153 \ (\text{wt.} = 23.96) \end{aligned}$$

Name of star.	Clamp.	T.			B *b*.	A *a*.	C *c*.	T′.			A. R.			Δ T.	
		h.	*m.*	*s.*	*s.*	*s.*	*s.*	*h.*	*m.*	*s.*	*h.*	*m.*	*s.*	*m.*	*s.*
16 Pegasi	W.	21	50	31.72	+ 0.14	— 0.09	— 0.18	21	50	31.59	21	47	34.41	— 2	57.18
17 Pegasi	W.		54	0.76	+ 0.11	— 0.15	— 0.17		54	00.55	21	51	03.42	2	57.13
20 Pegasi	W.	21	58	10.26	+ 0.11	— 0.15	— 0.17	21	58	10.05	21	55	12.67	2	57.38
π^1 Pegasi	W.	22	06	50.40	+ 0.15	— 0.05	— 0.19	22	06	50.31	22	03	53.04	2	57.27
24 Cephei	W.		10	28.51	+ 0.35	+ 0.49	— 0.52		10	28.83	22	07	31.20	2	57.63
31 Pegasi	E.		18	32.04	+ 0.12	— 0.15	+ 0.17		18	32.18	22	15	34.75	2	57.43
Piazzi XXII. 113	E.		25	11.98	+ 0.16	— 0.06	+ 0.19		25	12.27	22	22	14.75	2	57.52
38 Pegasi	E.		27	27.80	+ 0.16	— 0.06	+ 0.19		27	28.09	22	24	30.85	2	57.24
Piazzi XXII. 158	E.		32	57.59	+ 0.14	— 0.12	+ 0.17		32	57.78					
31 Cephei	E.		35	45.12	+ 0.41	+ 0.54	+ 0.56		35	46.63	22	32	49.44	2	57.19
λ Pegasi	E.		43	40.42	+ 0.14	— 0.10	+ 0.18		43	40.64	22	40	43.24	2	57.40
ι Cephei	E.	22	48	20.60	+ 0.31	+ 0.30	+ 0.40	22	48	21.61	22	45	24.48	— 2	57.13

NORMAL EQUATIONS.

$$a_0 = -0^{s}.20 \qquad c_0 = +0^{s}.20 \qquad \Delta T_0 = -2^{m}\ 57^{s}.33 \text{ for } 22^{h}.5$$

$$0 = +\overset{s.}{0.014} + 8.71\, d\,\Delta T + 1.12\, da + 1.17\, dc$$

$$0 = +0.265 + 1.12\, d\,\Delta T + 3.29\, da - 1.48\, dc$$

$$0 = +0.504 + 1.17\, d\,\Delta T - 1.48\, da + 18.61\, dc$$

$$d\,\Delta T = +\overset{s.}{0.016} \quad \Delta T = -\overset{m.}{2}\ \overset{s.}{57.314} \text{ (wt.} = 8.18)$$

$$da = -0.102 \quad a = -\ 0.302 \text{ (wt.} = 3.00)$$

$$dc = -0.036 \quad c = +\ 0.164 \text{ (wt.} = 17.61)$$

Final results of longitude.

Signals sent from—	Recorded at—	Mean of signals sent and received.	Time corrections.	Corrected time.	Difference of longitude.	Double wave time.	
		h. m. s.	*h. m. s.*	*h. m. s.*	*m. s.*		*m. s.*
Sept. 7, 1878:							
Ogden	Ogden	21 54 14. 00	− 2 58. 71	21 51 15. 29			
	Fort Bliss	13 6 58. 95	+9 6 19. 78	22 13 18. 73	22 3. 44		
Fort Bliss	Ogden	22 11 38. 63	− 2 58. 75	22 8 39. 88			
	Fort Bliss	13 24 20. 00	+9 6 22. 71	22 30 42. 71	22 2. 83	0. 61	22 3. 1
Sept. 8, 1878:							
Ogden	Ogden	21 1 0. 00	− 3 2. 20	20 57 57. 80			
	Fort Bliss	12 9 48. 03	+9 10 13. 30	21 20 1. 33	22 3. 53		
Fort Bliss	Ogden	21 19 45. 58	− 3 2. 24	21 16 43. 34			
	Fort Bliss	12 28 30. 00	+9 10 16. 45	21 38 46. 45	22 3. 11	0. 42	3. 3
Sept. 10, 1878:							
Ogden	Ogden	21 8 52. 00	− 3 2. 27	21 5 49. 73			
	Fort Bliss	12 9 36. 91	+9 18 16. 52	21 27 53. 43	22 3. 70		
Fort Bliss	Ogden	21 30 55. 29	− 3 2. 26	21 27 53. 03			
	Fort Bliss	12 31 36. 00	+9 18 20. 23	21 49 56. 23	22 3. 20	0. 50	3. 4
Sept. 11, 1878:							
Ogden	Ogden	21 10 2. 00	− 2 59. 61	21 7 2. 39			
	Fort Bliss	12 6 46. 45	+9 22 19. 37	21 29 5. 82	22 3. 43		
Fort Bliss	Ogden	21 17 29. 02	− 2 59. 60	21 14 29. 42			
	Fort Bliss	12 14 12. 00	+9 22 20. 61	21 36 32. 61	22 3. 19	0. 24	3. 3
Sept. 12, 1878:							
Ogden	Ogden	21 19 38. 00	− 2 57. 40	21 16 40. 60			
	Fort Bliss	12 12 21. 23	+9 26 22. 67	21 38 43 90	22 3. 30		
Fort Bliss	Ogden	21 25 45. 97	− 2 57. 39	21 22 48. 58			
	Fort Bliss	12 18 28 00	+9 26 23. 70	21 44 51. 70	22 3. 12	0. 18	22 3. 2

Final difference of longitude: $22^{m}\ 3^{s}.285 \pm 0^{s}.036$.
or, $5^{\circ}\ 30'\ 49''.27 \pm 0.''54$.

Subtracting this from the longitude of Ogden, 111° 59′ 54″.64 as given in Vol. I page 489, of the quarto reports of this survey, we obtain 106° 29′ 5″.37 for the longitu of Fort Bliss; that is, for the astronomical monument in the public square of the vi lage of El Paso, El Paso County, Texas.

The personal equation between Mr. Rock and Professor Safford was thus determine by an apparatus, by five groups of observations.

Rock—Safford.

1879.	*s.*
First group, April 14, p. m	—0. 1
Second group, April 15, a. m	—0. 0
Third group, April 15, a. m	+0. 0
Fourth group, April 15, p. m	+0. 0
Fifth group, April 15, p. m	+0. 2
Mean	+0. 0

This value has been neglected as too uncertain. The numbers (with their prop signs) are to be applied to the clock corrections given by Professor Safford.

Mean place of stars for 1878.0 *used for the determination of latitude of Fort Bliss, Tex.*

No. of pair.	No. B.A.C.	Class.	Right Ascension.	Declination.
			h. m. s.	° ′ ″
	6143	A.	18 1 34	+ 9 32 52.2
	6185	A.	8 2	54 15 1.8
	6203	A.	11 51	42 7 6.8
	6231	A.	15 8	21 54 39.5
	6251	A.	18 30	21 42 55.8
	6268	A.	20 13	39 26 30.0
	6300	A.	24 32	23 47 10.6
	6348	C.	30 28	56 57 9.4
	[1]	D.	30 43	6 34 55.0
	[2]	C.	33 1	43 7 8.9
	6387	A.	40 32	20 25 50.4
	[3]	C.	43 21	31 37 9.4
	6427	A.	45 19	32 24 41.1
	6460	A.	50 9	4 2 46.8
	6463	AA.	49 24	59 14 22.2
	6476	C.	51 34	48 42 27.2
	6487	AA.	54 5	14 54 14.0
	[4]	D.	57 9	50 21 43.0
	6528	AA.	18 59 48	13 41 0.2
	6553	A.	19 2 49	32 18 38.3
	6571	A.	7 5	31 4 51.5
	6599	A.	12 8	37 55 1.9
	6637	A.	17 51	26 1 46.0
	6667	A.	21 45	36 4 26.7
	6690	A.	25 48	27 42 16.3
	6709	A.	29 13	19 30 29.4
	6731	C.	32 51	44 25 33.0
	6734	A.	33 10	49 56 21.1
	[5]	C.	35 26	13 32 1.4
	6748	B.	35 56	54 41 15.8
	6802	AA.	44 50	8 32 50.3
	6833	AA.	49 19	6 6 11.6
	6847	B.	50 47	57 12 14.8
	6893	A.	19 58 11	6 56 5.2
	6976	A.	20 10 33	56 11 41.3
	6979	A.	11 34	24 17 46.8
	7008	A.	15 50	39 1 9.7
	7062	A.	23 19	48 58 45.0
	7085	A.	26 17	48 32 31.8
	7091	A.	27 33	48 48 32.4
	7107	B.	29 36	14 15 16.4
	7121	A.	31 50	14 10 18.6
	7160	A.	35 34	14 8 59.8
	7173	A.	37 46	14 38 16.8
	7213	AA.	20 42 39	36 2 35.2
	7256	AA.	49 21	27 35 40.1
	7271	A.	20 52 33	10 22 9.5
	7332	C.	21 0 4	52 48 1.7
	7365	A.	6 29	53 3 55.3
	[6]	C.	20 54 10	16 21 3.0
	7301	A.	55 41	47 2 42.6
	7345	A.	21 2 24	47 9 31.2
	7368	AA.	7 45	29 43 38.1
	7399	B.	12 54	34 23 7.5
	7410	A.	15 33	23 20 34.0
	7474	A.	24 25	23 6 17.4
	7521	A.	32 3	39 51 57.7
	7555	C.	36 41	54 19 4.1
	7561	AA.	38 12	9 18 58.6
	[7]	C.	43 26	38 4 55.6
	7627	AA.	47 31	25 21 6.3
	7641	A.	50 59	11 29 52.1
	7676	B.	57 22	52 17 40.2
	7688	AA.	21 59 31	− 0 54 42.8
	7700	A.	22 0 15	+64 2 0.7
	7723	A.	4 3	5 35 53.6
	7749	A.	6 37	57 36 0.8
	7796	A.	15 31	11 35 27.7
	7815	AA.	18 46	51 37 5.5
	7855	A.	26 16	49 39 20.2
	[9]	B.	34 49	13 54 28.9
	[8]	C.	35 17	53 12
	7908	AA.	35 23	10 11 41.9
	7932	A.	38 39	41 10 45.4
	7945	A.	40 39	22 55 26.5
	7958	A.	44 7	23 57 38.0
	7984	B.	48 31	39 43 35.7
	7995	B.	51 5	49 4 56.6
	8034	AA.	22 58 41	14 32 56.9
	8059	B.	23 2 13	48 37 52.9
	8082	A.	6 58	48 44 23.7
	8128	A.	14 4	41 24 37.5
	8160	A.	19 17	22 43 57.4
	8177	A.	21 47	5 42 32.2
	8188	B.	24 24	57 52 35.3
	8233	AA.	33 41	4 57 54.2
	8268	A.	41 6	57 58 20.9
	8310	A.	48 18	56 49 13.9
	8331	AA.	53 3	6 11 16.3

[1] 112 Heis Ophiuchi.
[2] 14* Heis Lyræ.
[3] 26 Heis Lyræ.
[4] 179 Heis Draconis.
[5] 67 Heis Aquilæ (980).
[6] 30 Heis Delphini (1254).
[7] 194 Heis Cygni (1382).
[8] Piazzi XXII 186 (No. 1519).
[9] 30* Heis Lacertæ.

Observations and computations for latitude of Fort Bliss, Tex.

Date.	Number of star.	Micrometer readings.	Level.		Half sum of declination.	Corrections.			Latitude.
			N.	S.		Micr. and refr.	Level.	Merid.	
					° ′ ″	′ ″	″		° ′ ″
August 29, 1878	6734	14.906	18.2	18.0	31 44 24.2	+ 1 2.9	−2.6	....	31 45 24.5
	....	12.882	13.4	22.0					
	6893	− 6.058	8.8	29.6	31 34 6.9	+11 32.6	−8.1	....	31.4
	6976	28.358	16.8	22.2					
	7062	15.471	18.2	21.4	31 42 42.3	+ 2 48.1	+0.1	....	30.5
	7085	40.798	16.0	23.6					
	7091	25.373	16.0	23.8					
	7173	21.799	23.2	16.8					
	....	19.212	14.0	25.2	31 45 33.7	− 0 2.8	−2.3	....	28.6
	7345	19.123	22.2	18.4					
	7368	2.828	24.0	17.0	32 3 40.2	−18 7.3	+0.4	....	33.3
	7399	37.836	17.8	23.4					
	[7410	17.971	4.0	37.0]					
	7474	3.448	6.0	35.0	31 29 25.4	+16 10.8	−7.4	....	28.8
	7521	34.705	23.0	18.0					
	7555	15.453	10.0	30.8	31 49 19.1	− 3 34.8	−9.4	....	34.9
	7561	22.367	15.4	24.8					
	....	19.843	23.0	18.2	31 43 19.3	+ 2 9.5	+0.7	....	29.5
	7627	24.013	19.4	22.0					
	7641	7.452	20.0	21.8	31 54 4.3	− 8 29.7	−1.9	....	32.7
	7676	23.862	19.0	23.2					
	7723	10.546	26.4	15.4	31 36 15.4	+ 9 14.3	−0.7	....	31 45 29.0
	7749	28.393	14.4	27.8					
	7796*	28.681	25.0	17.8	31 36 35.2	+ 7 42.2	−2.4	....	31 44 [15.0]
	7815	13.800	13.4	28.2					
	7855	23.740	23.4	19.8	31 47 13.7	− 1 48.7	+4.4	....	31 45 29.4
	....	20.241	26.6	16.0					
	7958	22.183	19.8	23.4	31 50 56.2	− 5 23.4	−1.9	....	30.9
	7984	11.772	20.0	22.6					
	7995	8.096	15.0	27.4	31 41 20.0	+ 4 15.9	−2.4	....	33.5
	8034	15.134	20.8	21.0					
	8059	34.150	17.8	24.0					
	8082	27.876	19.0	22.8					
	8128	3.554	26.0	14.4	32 4 37.0	−19 9.4	+6.6	....	34.2
	8160	40.560	25.6	16.0					
	8177	40.624	18.8	22.8	31 49 19.3	− 3 47.0	−2.1	....	30.2
	8188	36.113	19.0	23.0					
	8268	30.521	20.2	21.8					
	8310	33.734	......	......	31 30 34.6	+14 57.2	0.	....	31.8
	8331	4.847	......	......					
August 25, 1878	....	16.762	24.2	29.8	31 46 40.0	− 1 5.4	−1.3	....	33.3
	6387	18.868	27.8	26.4					
	....	34.494	34.4	19.8	32 1 6.3	−15 56.2	+21.7	....	31.8
	6427	3.708	55	—0.5					
	6667	27.794	22.8	32.8	31 53 34.6	− 8 1.2	− 4.0	....	29.4
	6690	12.302	26.2	29.0					
	6833	13.971	18.2	38.0	31 39 26.3	+ 5 51.8	+11.1	....	29.2
	6847	25.298	55	—0.5					
	6893	32.604	17.6	39.0	31 34 7.1	+11 30.7	− 7.4	....	30.4
	6976	10.366	27.0	29.4					
	7271	29.246	22.4	33.4	31 39 19.7	+ 6 7.5	+ 2.6	....	31 45 29.8
	7332	9.724	37.6	18.2					
	7365	25.106	37.6	18.4					

*Some error; I cannot find what it is.

Observations and computations for latitude of Fort Bliss, Tex.—Continued.

Date.	Number of star.	Micrometer readings.	Level.		Half sum of declination.	Corrections.			Latitude.
			N.	S.		Micr. and refr.	Level.	Merid.	
					° ′ ″	′ ″	″		° ′ ″
August 25, 1878	7410	18.463	32.6	23.8	31 32 50.7	+12 33.1	− 8.7	....	31 45 24.1
	7474	4.640	33.0	23.6					
	7521	35.798	10.0	47.2					
	7555	14.564	17.0	40.4	31 49 19.3	− 3 45.5	− 5.7	....	28.1
	7561	21.823	31.0	26.0					
	....	17.679	27.2	29.8	31 43 19.6	+ 2 12.0	− 3.7	....	27.9
	7627	21.930	24.0	33.2					
	7641	9.893	33.0	25.2	31 54 4.5	− 8 41.4	+ 9.9	....	33.0
	7676	26.681	41.4	17.2					
	7958	20.596	27.2	32.8	31 50 56.4	− 5 24.0	− 6.1	....	26.3
	7984	10.165	23.0	37.2					
	7905	9.061	25.0	35.6	31 44 8.2	+ 1 20.8	+ 5.5	....	34.5
	8034	16.271	30.2	30.2					
	8062	28.650	53.0	7.0					
ugust 27, 1878	6599	33.185	28.4	23.8	31 58 37.0	−13 7.3	− 0.9	....	28.8
	6637	7.836	22.6	30.0					
	6667	7.830	25.8	26.8	31 53 35.0	− 8 10.1	+11.1	....	36.0
	6690	23.610	44.0	7.2					
	6734	18.088	26.0	26.4	31 44 24.7	+ 1 0.0	+ 9.8	....	34.5
	....	20.020	42.2	10.2					
	6833	15.064	24.8	28.0	31 39 26.7	+ 5 59.4	+ 4.7	....	30.8
	6847	26.634	35.4	16.8					
	6893	32.266	23.8	29.8	31 34 7.5	+11 21.7	+ 2.3	....	31.5
	6976	10.317	33.2	19.8					
	*7062	20.822	35.0	19.0	31 36 28.5	+ 9 7.5	− 1.9	....	34.1
	*7085	44.208	34.4	19.6					
	[*7091	30.567]	......	......					
	7107	4.563	4.2	50.0					
	7173	27.207	28.8	26.0					
	7213	21.463	34.8	19.8	31 49 24.9	− 3 58.4	+ 5.6	....	32.1
	7256	13.786	29.0	26.0					
	....	17.156	23.4	31.8	31 43 52.2	+ 1 43.4	− 6.1	....	29.5
	7301	10.535	22.8	32.4					
	7345	17.119	21.2	34.2					
gust 29, 1878	6203	3.140	35.4	37.0	31 58 6.7	−12 32.9	− 3.6	....	30.2
	6235	33.055	32.2	40.0					
	6251	21.707	30.0	42.2					
	6268	10.607	29.6	43.2	31 37 0.4	+ 8 32.6	− 5.0	....	28.0
	6300	27.111	35.0	37.6					
	6348	18.472	28.0	18.8	31 46 11.6	− 0 27.0	− 6.9	....	[37.7]
	....	19.341	7.0	38.4					
	... .	20.458	24.0	22.3	31 46 40.5	− 1 3.5	− 3.9	... .	33.1
	6387	18.413	15.8	30.2					
	... .	3.765	28.0	18.2	32 1 6.9	−15 41.1	− 3.1	....	22.7
	6427	34.063	13.2	33.0					
	6463	13.083	18.6	27.8	31 38 44.8	+ 6 54.6	− 7.9	....	31.5
	6460	26.431	15.0	31.4					
	6476	16.832	16.6	29.6	31 48 32.0	− 3 0.8	− 5.6	....	25.6
	†6487	18.652	20.8	25.8					
	....	34.612	19.8	26.4	32 1 33.3	−15 58.2	− 3.2	....	31.0
	6528	3.763	16.4	30.0					
	6553	20.624	14.0	32.0	31 41 54.7	+ 3 38.2	− 3.5	....	31 45 29.4
	6571	13.598	26.4	10.8					

*7085 should read 46^{r}. The instrument probably jumped before 7091; this star has been omitted.

† Probably 22.652.

Observations and computations for latitude of Fort Bliss, Tex.—Continued.

Date.	Number of star.	Micrometer readings.	Level.		Half sum of declination.	Corrections.			Latitude.
			N.	S.		Micr. and refr.	Level.	Merid.	
					° ′ ″	′ ″	″		° ′ ″
August 29, 1878	6599	33.435	40.0	6.4	31 58 37.3	−13 11.4	− 2.0	....	31 45 23.9
	6637	7.954	3.4	43.4					
	6667	10.314	28.4	18.2	31 53 35.3	− 7 59.7	− 2.4	....	33.2
	6690	25.768	14.0	31.8					
	6979	10.460	16.8	28.8	31 39 44.5	+ 5 52.5	− 5.0	....	32.0
	7008	21.810	21.2	25.4					
	7062	24.171	22.4	24.4	31 37 44.6	+ 7 51.8	− 5.0	....	31.4
	7091	34.037	21.8	25.4					
	7107	8.093	15.8	30.2					
	7121	3.275	15.6	30.2					
	7173	30.374	18.0	29.0					
	7213	21.539	18.0	29.0	31 49 25.4	− 3 54.2	− 4.6	....	26.6
	7256	13.999	22.0	25.8					
	(*)	*13.067	21.8	26.2	31 43 52.8	+ 1 42.1	− 3.1	....	31.8
	7301	11.524	21.0	26.8					
	*7345	18.035	†26.2	26.8					
	7555	22.988	32.4	16.6	31 49 20.3	− 3 45.5	− 8.1	....	26.7
	7561	15.728	3.8	45.6					
	7641	8.583	16.8	33.0	31 54 5.7	− 8 30.4	− 4.4	....	30.9
	7676	25.016	25.6	23.6					
	7723	9.362	27.2	21.6	31 36 16.6	+ 9 20.4	− 7.9	....	29.1
	7749	27.404	9.0	39.8					
	7796	27.435	20.6	28.4	31 36 36.5	+ 8 58.8	− 7.3	....	28.0
	7815	10.089	16.2	31.8					
	7958	17.051	24.2	25.0	31 50 57.5	− 5 14.2	− 6.2	....	37.1
	7984	27.166	14.8	34.0					
	7995	28.533	31.0	18.8	31 44 9.2	+ 1 23.2	− 2.4	....	30.0
	8034	21.113	23.4	26.2					
	8082	8.338	13.2	35.4					
	8128	44.745	32.6	17.6	32 4 38.3	−19 16.1	+ 8.1	....	30.2
	8160	7.523	30.4	19.4					
	8177	3.926	16.8	33.6	31 38 11.1	+ 7 26.1	− 6.4	....	30.8
	8188	8.303	23.0	27.2					
	8233	46.945	16.8	34.0					
	8268	13.845	24.0	26.8					
	8310	6.926	24.2	26.2	31 30 35.6	+15 1.9	− 5.8	....	31.9
	8331	35.964	17.2	34.0					
August 30, 1878	6143	10.976	27.4	12.6	31 54 5.2	− 8 36.9	+ 2.9	....	31.2
	6185	27.619	16.8	22.2					
	6203	42.846	7.4	32.8	31 58 6.8	−12 33.5	+ 3.9	....	37.2
	6231	12.851	42.0	−2.6					
	6251	24.319	35.8	4.2					
	6268	27.459	16.4	23.6	31 37 0.6	+ 8 27.6	+ 2.7	....	30.9
	6300	11.116	28.0	12.0					
	6348	17.623	15.6	23.0	31 46 11.7	− 0 33.1	+ 4.9	....	43.5
	....	16.558	31.3	8.0					
	... ...	13.117	21.4	18.6	32 1 33.5	−16 1.8	+12.0	....	43.7
	6528	44.084	38.0	2.0					
	6553	26.903	23.0	17.8	31 41 54.9	+ 3 28.1	+ 5.1	....	28.1
	6571	33.607	25.8	14.6					
	6599	15.767	20.2	20.8	31 58 37.4	−13 5.3	+ 7.3	....	39.4
	6637	41.051	32.8	8.6					
	6667	38.150	23.4	18.0	31 53 35.5	− 8 4.9	+ 3.7	....	31 45 34.3
	6690	22.537	24.0	17.6					

*Read 18.067.

† 21.2 26.8 seems the correct level reading.

Observations and computations for latitude of Fort Bliss, Tex.—Continued.

Date.	Number of star.	Micrometer readings.	Level.		Half sum of declination.	Corrections.			Latitude.
			N.	S.		Micr. and refr.	Level.	Merid.	
					° ′ ″	′ ″	″		° ′ ″
August 30, 1878	6709	16.707	23.2	18.0	31 58 15.3	−12 45.0	+ 3.6	....	31 45 33.9
	6731	41.338	24.0	17.6					
	6748	19.363	13.4	28.2	31 37 17.2	+ 8 9.6	+ 4.0	....	30.8
	6802	35.127	35.0	7.4					
	6833	33.096	20.8	22.0	31 39 27.2	+ 6 2.4	+ 0.9	....	30.5
	6847	21.427	23.2	19.2					
	*6893	14.673	20.0	22.4	31 34 8.1	+11 17.5	+ 5.0	....	30.6
	6976	16.485	30.0	11.6					
	6979	34.464	9.0	33.4	31 39 44.7	+ 5 53.8	− 5.9	....	32.6
	7008	23.072	23.8	18.4					
	7062	19.178	18.6	24.0	31 36 12.4	+ 9 14.3	+ 3.0	....	29.7
	7091	9.280	17.8	25.0					
	7107	34.910	29.8	13.4					
	7121	39.675	29.2	13.8					
	7160	†39.992	29.0	13.6					
	7173	12.723	29.4	13.2					
	7213	26.964	21.0	22.8	31 49 25.6	− 3 55.0	+ 2.4	....	32.0
	7256	34.530	27.0	17.6					
	....	29.419	32.0	12.6	31 43 52.9	+ 1 35.6	+ 2.4	....	30.9
	7301	‡30.774	16.8	27.8					
	7345	29.220	16.0	28.6					
	7368	6.371	27.6	18.0	32 3 41.7	−18 9.9	+ 9.4	....	41.2
	7399	41.461	33.0	12.4					
	7555	15.972	15.8	29.8	31 49 20.5	− 3 49.9	− 0.6	....	30.0
	7561	23.374	29.0	16.8					
	7688	19.093	19.0	26.6	31 33 58.1	+11 29.8	+ 3.1	....	31.0
	7700	41.302	31.0	13.4					
	7723	38.558	18.2	27.4	31 36 16.8	+ 9 11.8	+ 2.0	....	30.6
	7749	20.791	30.6	15.0					
	7796	18.772	21.6	24.0	31 36 36.8	+ 8 48.0	+ 5.4	....	30.2
	7815	35.773	32.8	13.0					
	7932	6.080	25.8	20.2	32 3 26.8	−17 53.2	+ 9.8	....	43.4
	7945	40.632	36.0	10.0					
	7958	31.159	27.6	18.4	31 50 57.8	− 5 23.6	+ 1.0	....	35.2
	7984	20.740	20.0	26.0					
	7995	19.168	19.0	27.2	31 41 21.6	+ 4 6.9	+ 4.3	....	32.8
	8034	26.526	40.4	6.4					
	8059	§44.247	11.2	35.2					
	8082	39.013	9.2	37.8					
	8128	5.160	19.2	27.6	32 4 38.6	−19 5.7	− 0.5	....	32.4
	8160	42.048	26.8	20.0					
	8177	‖46.160	16.0	30.0	31 49 20.8	− 3 47.1	+ 0.4	....	? 34.1
	8188	40.081	31.0	15.0					
	8268	34.527	30.2	15.8					
	8310	43.543	27.0	20.0	31 30 36.0	+14 51.4	+ 3.5	....	30.9
	8331	14.843	25.8	21.4					
September 1, 1878 ..	6203	39.107	32.0	25.8	31 58 7.0	−12 33.1	− 0.2	....	33.7
	6231	9.188	26.4	31.4					
	6251	20.534	24.4	33.2					
	6268	28.208	18.0	40.2	31.37 0.8	+ 8 39.2	− 6.3	....	33.7
	6300	11.491	29.8	28.0					
	6463	20.643	21.2	8.0	31 38 45.1	+ 6 40.1	+ 6.4	....	31 45 31.6
	6460	33.525	18.6	11.2					

*Micr. diff. 20^{r}. in error. †40^{r}.992. ‡35^{r}.774. §45^{r}.247. ‖44^{r}.616. ?

Observations and computations for latitude of Fort Bliss, Tex.—Continued.

Date.	Number of star.	Micrometer readings.	Level. N.	Level. S.	Half sum of declination.	Corrections. Micr. and refr.	Corrections. Level.	Corrections. Merid.	Latitude.
					° ′ ″	′ ″	″		° ′ ″
September 1, 1878 ..	6476 6487	25.253 31.154	19.4 18.0	10.4 11.8	31 48 32.5	− 3 3.3	+ 4.7	....	31 45 33.94
	 6528	40.637 9.943	12.0 9.8	17.8 20.6	32 1 33.8	−15 53.4	− 5.1	....	35.3
	6553 6571	26.901 20.145	*10.0 18.0	11.0 12.4	31 41 55.2	+ 3 29.8	+ 4.5	....	29.5
	6599 6637	40.473 14.739	25.4 28.4	5.8 3.0	31 58 37.7	−13 19.3	+14.0	....	32.4
	6667 6690	17.772 33.500	21.4 19.0	10.0 12.6	31 53 35.8	− 8 8.5	+ 5.5	....	32.8
	6709 6731	†18.087 13.128	28.0 15.0	3.6 16.8	31 58 15.6	−12 55.2	+ 7.0	....	27.4
September 2, 1878 ..	.... 7301 7345	‡25.092 32.166 25.658	25.4 35.0 32.0	17.0 6.8 9.2	31 43 53.6	+ 1 27.6	+10.5	....	31.7
	7474 7521	11.832 42.444	29.0 28.4	13.0 14.2	31 29 27.6	+15 50.8	+ 9.4	....	27.8
	7555 7561	21.892 28.964	16.2 13.0	26.6 29.8	31 49 21.2	− 3 39.7	− 8.4	....	33.1
	 7627	24.355 28.456	25.6 16.0	17.8 22.4	31 43 21.6	+ 2 7.4	+ 0.4	....	29.4
	7641 7676	16.064 32.651	23.8 23.0	19.8 20.6	31 54 6.5	− 8 35.2	+ 2.0	....	33.3
	§7688 7700	26.112 38.474	23.6 16.8	18.8 27.0	31 33 58.8	+11 34.6	− 1.7	....	31.7
	7723 7749	34.603 16.729	18.2 20.4	25.2 23.4	31 36 17.4	+ 9 15.2	− 3.1	....	29.5
	‖7796 7815	26.702 33.901	23.4 16.0	20.6 28.0	31 36 37.5	+ 8 54.2	− 2.9	....	28.8
	7855 7912	20.205 23.633	12.0 30.8	32.0 13.4	31 47 16.0	− 1 43.7	− 0.8	....	31.5
	7932 7945	40.050 5.465	18.2 15.6	26.4 29.0	32 3 27.6	−17 54.2	− 6.7	....	26.7
	7958 7984	22.471 82.815	24.4 21.4	20.4 23.8	31 50 58.6	− 5 21.3	+ 0.5	....	37.8
	7995 8034 8059 8082	35.549 28.300 9.430 15.718	28.4 8.0 35.0 36.2	16.6 37.6 10.0 9.4	31 41 22.4	+ 4 10.6	− 2.6	....	30.4
	8128 8160	44.621 7.818	26.0 30.2	19.8 15.8	32 4 30.3	−19 3.1	+ 6.4	....	42.6
	8177 8188 8233 8268	4.008 8.590 47.043 14.156	16.6 26.6 16.2 25.0	29.2 19.4 29.6 20.8	31 38 12.1	+ 7 19.6	− 2.3	....	29.4
	¶8310 8331	9.909 36.688	35.0 39.6	11.8 36.4	31 30 36.7	+13 51.8	....	....	....
September 4, 1878 ..	6348	26.153 25.301	20.4 2.6	16.0 34.0	31 46 12.2	− 0 26.5	− 8.4	....	[37.3]
	(**) 6387	22.712 25.797	18.8 13.6	18.0 22.4	31 46 41.2	− 1 4.8	− 2.5	....	33.9
	 6427	41.415 11.189	24.4 11.6	12.2 24.8	32 1 7.7	−15 38.8	− 0.3	....	31 45 28.6

* Should read 20.0 11.0. † 38^{r}.087. ‡ 26^{r}.092. § Diff. 22^{r}.362, not 12^{r}.362. ‖ Diff. 17^{r}.199, not 7^{r}.199.

¶ Level unintelligible. ** Diff. 2^{r}.085 instead of 3^{r}.085.

Observations and computations for latitude of Fort Bliss, Tex.—Continued.

Date.	Number of star.	Micrometer readings.	Level.		Half sum of declination.	Corrections.			Latitude.
			N.	S.		Micr. and refr.	Level.	Merid.	
					° ′ ″	′ ″	″		° ′ ″
eptember 4, 1878 . .	6463 6460	30.863 17.642	18.8 14.0	18.4 21.8	31 38 45.5	+ 6 50.6	− 2.3	....	31 45 33.8
	6476 6487	27.337 21.347	4.4 29.0	32.6 8.0	31 48 32.8	− 3 6.0	− 2.2	....	24.6
	 6528	9.135 39.969	15.8 25.8	21.6 11.4	32 1 34.2	−15 57.7	+ 2.7	....	39.2
	6553 6571	23.695 30.653	20.4 7.8	16.6 29.4	31 41 55.6	+ 3 36.1	− 5.5	....	26.2
	6599 6637	11.453 36.800	15.8 24.4	21.8 13.0	31 58 38.1	−13 7.2	+ 1.7	....	32.6
	*6667 6690	30.961 19.362	30.0 −0.6	7.2 38.0	31 53 36.3	− 8 4.5	− 4.9	....	26.9
	†6709 6731	13.266 27.852	24.0 10.0	13.6 27.4	31 58 16.1	−12 43.6	− 2.2	....	30.3
	‡6833 6847	22.381 24.155	27.8 48.2	9.8 −6.	31 39 28.0	+ 6 5.7	+22.4	....	[?56.1]
	7091 7107 7121 7160 7173	41.082 15.260 10.460 9.229 37.460	18.0 16.0 16.0 16.0 16.2	21.0 22.4 22.0 22.0 21.6	31 33 40.3	+11 53.8	− 2.8	....	31.3
	7213 7256	27.919 20.398	14.8 19.2	23.4 20.0	31 49 26.7	− 3 53.6	− 2.9	....	30.2
	.... 7301 7345	24.831 18.375 24.956	12.4 29.6 29.4	27.0 10.0 9.8	31 43 54.0	+ 1 38.3	+ 1.6	....	33.9
	7410 7474 7521	25.488 39.246 8.225	14.0 11.4 21.4	24.8 27.6 17.6	31 33 2.1	+12 29.8	− 3.0	....	28.9
	7555 7561	29.016 21.736	15.4 15.6	22.6 23.4	31 49 21.6	− 3 46.1	− 4.7	....	30.8
	 7627	24.953 20.754	25.6 20.8	13.4 18.0	31 43 22.2	+ 2 10.4	+ 4.7	....	37.3
	7641 7676	33.872 17.336	14.4 19.4	24.8 19.6	31 54 7.0	− 8 33.6	− 3.3	....	30.1
	7688 7700	35.717 13.236	9.2 20.6	29.8 18.8	31 33 59.2	+11 38.3	− 5.8	....	31.7
	7723 7749	16.235 34.132	18.0 12.6	21.0 26.8	31 36 17.8	+ 9 15.9	− 5.3	....	28.4
	7796 7815	35.115 18.003	12.0 30.8	27.4 9.0	31 36 38.0	+ 8 51.5	+ 2.0	....	31.5
	7855	29.502 25.834	34.0 22.6	5.6 16.8	31 47 16.5	− 1 53.9	+10.6	....	33.2
	7932 7945	10.532 45.202	16.8 24.6	23.2 15.0	32 3 28.1	−17 56.8	+ 1.0	....	32.3
	7958 7984	29.465 19.093	18.6 19.2	21.0 20.6	31 50 59.1	− 5 22.2	− 1.2	....	35.7
	7995 §8034 8059 8082	15.634 22.933 41.967 35.723	31.0 54.0 21.4 21.6	8.8 34.4 18.6 18.6	31 41 22.9	+ 4 13.9	− 6.4	....	30.4
	8128 8160	6.377 43.329	14.0 30.4	26.2 9.6	32 4 39.8	−19 7.7	+ 2.7	....	31 45 34.8

Diff. $15^{r}.599$. †Diff. $24^{r}.586$. ‡Diff. $11^{r}.774$.? §Level should read, 5.4 34.4.

Observations and computations for latitude of Fort Bliss, Tex.—Continued.

Date.	Number of star.	Micrometer readings.	Level. N.	Level. S.	Half sum of declination.	Corrections. Micr. and refr.	Corrections. Level.	Corrections. Merid.	Lati
					° ′ ″	′ ″	″		°
September 4, 1878 ..	8177	46.881	23.2	17.0	31 38 12.5	+ 7 19.2	− 1.1	....	31 4
	8188	42.248	48.0	22.2					
	8233	3.812	21.4	19.2					
	8268	36.727	15.0	26.0					
	*8310	20.415	17.4	23.8	31 30 37.1	+14 53.8	− 2.4	....	31 4
	8331	11.638	19.6	21.0					

*Diff. 28r.777.

Discussion of latitude—Fort Bliss.

No. of combinations.	No. of observations.	No. of stars.	Latitude.	Correction to micrometer.	Date rejected.	No. of combinations.	No. of observations.	No. of stars.	Latitude.	Correction to micrometer.	
			° ′ ″	″					° ′ ″	″	
1....	1	2	31 45 31.2	−0.60		20...	5	7	31 45 31.40	+0.57	
2....	3	3	33.70	−0.88		21...	4	2	30.48	−0.28	
3....	3	2	30.87	+0.60		22 ..	1	3	29.8	+0.43	
4....	3	2	[39.50]	−0.04		23...	6	3	31.07	+0.09	
5....	3	2	33.43	−0.08		24...	1	2	33.3	−1.27	A
6....	2	2	30.20	−1.11	Aug. 29	25...	4	3	27.40	+1.00	
7....	3	2	32.30	+0.48		26...	6	2	30.72	−0.26	
8....	3	2	28.37	−0.21		27...	4	2	31.37	+0.15	
9....	3	2	35.47	−1.12	Aug. 30	28...	5	2	32.00	−0.60	
10....	4	2	28.30	+0.24		29...	3	2	31.47	+0.81	
11....	5	2	31.42	−0.92		30...	5	2	29.32	+0.65	
12....	6	2	32.52	−0.57		31...	4	2	29.62	+0.62	A
13....	3	2	30.53	−0.90		32...	3	2	31.37	−0.13	
14....	2	2	29.50	+0.07		33 ..	2	2	29.50	−1.25	A
15....	1	2	30.8	+0.57		34 ..	6	2	33.83	−0.38	
16....	(*)	(*)	....	....		35 ..	6	4	31.93	+0.22	
17....	3	2	30.17	+0.41	Sept. 4	36...	4	2	32.80	−1.34	S
18....	4	2	30.98	+0.80		37...	5	4	31.06	+0.20	
19....	2	2	32.30	+0.34		38...	5	2	30.78	+1.04	

Pair 4; place of star [1] uncertain.

* Not observed.

Final latitude, 31° 45′ 31″.14 ± 0″.17.

NOTE.—The bell-tower of the cathedral in El Paso, Mexico, and the boundary monument on the bank of the Rio Grande, five miles above El Paso on the parallel of 31° 47′, were connected wi Fort Bliss astronomical monument by triangulation.

The same points were located by the Mexican Boundary Commission in 1852 and 1855.

Their longitudes were derived from that of the observatory at Frontera, determined by Maj. Emory from observations of moon culminations on 38 nights during 4 lunations; and from that observatory at San Elceario, determined by Lieut. W. F. Smith from similar observations on 32 during 5 lunations; each corrected by half the difference (0s.645) between the astronomical diff (1m 8s.59) and the assumed absolute difference of longitude (1m 7s.30), as determined by 56 signal of gunpowder simultaneously observed at the two places during 4 nights, thus:

Station.	Astronomical determination.	Correction due to flashes.	Final value.	In ar
	h. m. s.	s.	h. m. s.	° ′
Frontera (observatory)	7 06 13.02	− 00.65	= 7 06 12.37	= 106 33
San Elceario (observatory)...........	7 05 04.43	+ 00.64	= 7 05 05.07	= 106 16

Frontera is about 8 miles above and San Elceario 22 miles below El Paso.

The longitude of Sr. Salazar's observatory in El Paso, Mexico, was determined by Major Em 53 signal flashes during 4 nights to be 15s.94 east of Frontera. Hence its longitude is 7h 5m 56s 106° 29′ 6″.45. Its latitude was determined by Señor Salazar, the principal Mexican engineer, to 44′ 15″.7 north.

The bell-tower of the cathedral is 500 feet (5″.79) east and 200 feet (1″.98) north of Salazar's ob tory (Mexican boundary report, page 141). Hence its longitude is 106° 29′ 0″.66, and latitude 31° 44′

The longitude of the initial point of the boundary on the parallel of 31° 47′, in the Rio Grand derived from Frontera by a trigonometric survey by J. H. Clark, American assistant surveyor, 106° 31′ 26″.50 (page 190, vol. 1 of report). The monument on the right bank of the river is 2″.7 w the initial point as derived from the values of the longitudes of these two points given in table E 244, of Mexican boundary report. The resulting longitude is 106° 31′ 29″.20. Its latitude, 31° depends on that of the astronomical station on the left bank of the river, determined by J. H. Cla 108 observations on 22 pairs of stars, with the zenith telescope, to be 31° 46′ 51″.29.

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Observations and computations for latitude of Fort Bliss, Tex.—Continued.

Date.	Number of star.	Micrometer readings.	Level.		Half sum of declination.	Corrections.			Latitude.
			N.	S.		Micr. and refr.	Level.	Merid.	
					° ′ ″	′ ″	″		° ′ ″
September 4, 1878 ..	8177	46.881	23.2	17.0	31 38 12.5	+ 7 19.2	− 1.1	....	31 45 30.6
	8188	42.248	48.0	22.2					
	8233	3.812	21.4	19.2					
	8268	36.727	15.0	26.0					
	*8310	20.415	17.4	23.8	31 30 37.1	+14 53.8	− 2.4	....	31 45 28.5
	8331	11.638	19.6	21.0					

* Diff. $28^{r}.777$.

Discussion of latitude—Fort Bliss.

No. of combinations.	No. of observations.	No. of stars.	Latitude.	Correction to micrometer.	Date rejected.	No. of combinations.	No. of observations.	No. of stars.	Latitude.	Correction to micrometer.	Date rejected.
			° ′ ″	″					° ′ ″	″	
1....	1	2	31 45 31.2	−0.60		20...	5	7	31 45 31.40	+0.57	
2....	3	3	33.70	−0.88		21...	4	2	30.48	−0.28	
3....	3	2	30.87	+0.60		22 ..	1	3	29.8	+0.43	
4....	3	2	[39.50]	−0.04		23...	6	3	31.07	+0.09	
5....	3	2	33.43	−0.08		24...	1	2	33.3	−1.27	Aug. 30.
6....	2	2	30.20	−1.11	Aug. 29	25...	4	3	27.40	+1.00	
7....	3	2	32.30	+0.48		26...	6	2	30.72	−0.26	
8....	3	2	28.37	−0.21		27...	4	2	31.37	+0.15	
9....	3	2	35.47	−1.12	Aug. 30	28...	5	2	32.00	−0.60	
10....	4	2	28.30	+0.24		29...	3	2	31.47	+0.81	
11....	5	2	31.42	−0.92		30...	5	2	29.32	+0.65	
12....	6	2	32.52	−0.57		31...	4	2	29.62	+0.62	Aug. 24.
13....	3	2	30.53	−0.90		32...	3	2	31.37	−0.13	
14....	2	2	29.50	+0.07		33 ..	2	2	29.50	−1.25	Aug. 30.
15....	1	2	30.8	+0.57		34 ..	6	2	33.83	−0.38	
16....	(*)	(*)	....	....		35 ..	6	4	31.93	+0.22	
17....	3	2	30.17	+0.41	Sept. 4	36...	4	2	32.80	−1.34	Sept. 2.
18....	4	2	30.98	+0.80		37...	5	4	31.06	+0.20	
19....	2	2	32.30	+0.34		38...	5	2	30.78	+1.04	

Pair 4; place of star [1] uncertain. * Not observed.

Final latitude, 31° 45′ 31″.14 ± 0″.17.

NOTE.—The bell-tower of the cathedral in El Paso, Mexico, and the boundary monument on the righ bank of the Rio Grande, five miles above El Paso on the parallel of 31° 47′, were connected with the Fort Bliss astronomical monument by triangulation.

The same points were located by the Mexican Boundary Commission in 1852 and 1855.

Their longitudes were derived from that of the observatory at Frontera, determined by Maj. W. H. Emory from observations of moon culminations on 38 nights during 4 lunations; and from that of the observatory at San Elceario, determined by Lieut. W. F. Smith from similar observations on 32 nights during 5 lunations; each corrected by half the difference ($0^{s}.645$) between the astronomical difference ($1^{m}\ 8^{s}.59$) and the assumed absolute difference of longitude ($1^{m}\ 7^{s}.30$), as determined by 56 signal flashes of gunpowder simultaneously observed at the two places during 4 nights, thus:

Station.	Astronomical determination.	Correction due to flashes.	Final value.	In arc.
	h. m. s.	s.	h. m. s.	° ′ ″
Frontera (observatory)	7 06 13.02	− 00.65	= 7 06 12.37	= 106 33 05.55
San Elceario (observatory)...........	7 05 04.43	+ 00.64	= 7 05 05.07	= 106 16 16.05

Frontera is about 8 miles above and San Elceario 22 miles below El Paso.

The longitude of Sr. Salazar's observatory in El Paso, Mexico, was determined by Major Emory by 53 signal flashes during 4 nights to be $15^{s}.94$ east of Frontera. Hence its longitude is $7^{h}\ 5^{m}\ 56^{s}.43$, or 106° 29′ 6″.45. Its latitude was determined by Señor Salazar, the principal Mexican engineer, to be 31° 44′ 15″.7 north.

The bell-tower of the cathedral is 500 feet (5″.79) east and 200 feet (1″.98) north of Salazar's observatory (Mexican boundary report, page 141). Hence its longitude is 106° 29′ 0″.66, and latitude 31° 44′ 17″.68.

The longitude of the initial point of the boundary on the parallel of 31° 47′, in the Rio Grande, was derived from Frontera by a trigonometric survey by J. H. Clark, American assistant surveyor, given 106° 31′ 26″.50 (page 190, vol. 1 of report). The monument on the right bank of the river is 2″.7 west of the initial point as derived from the values of the longitudes of these two points given in table E, page 244, of Mexican boundary report. The resulting longitude is 106° 31′ 29″.20. Its latitude, 31° 47′ 0″, depends on that of the astronomical station on the left bank of the river, determined by J. H. Clark by 108 observations on 22 pairs of stars, with the zenith telescope, to be 31° 46′ 51″.29.

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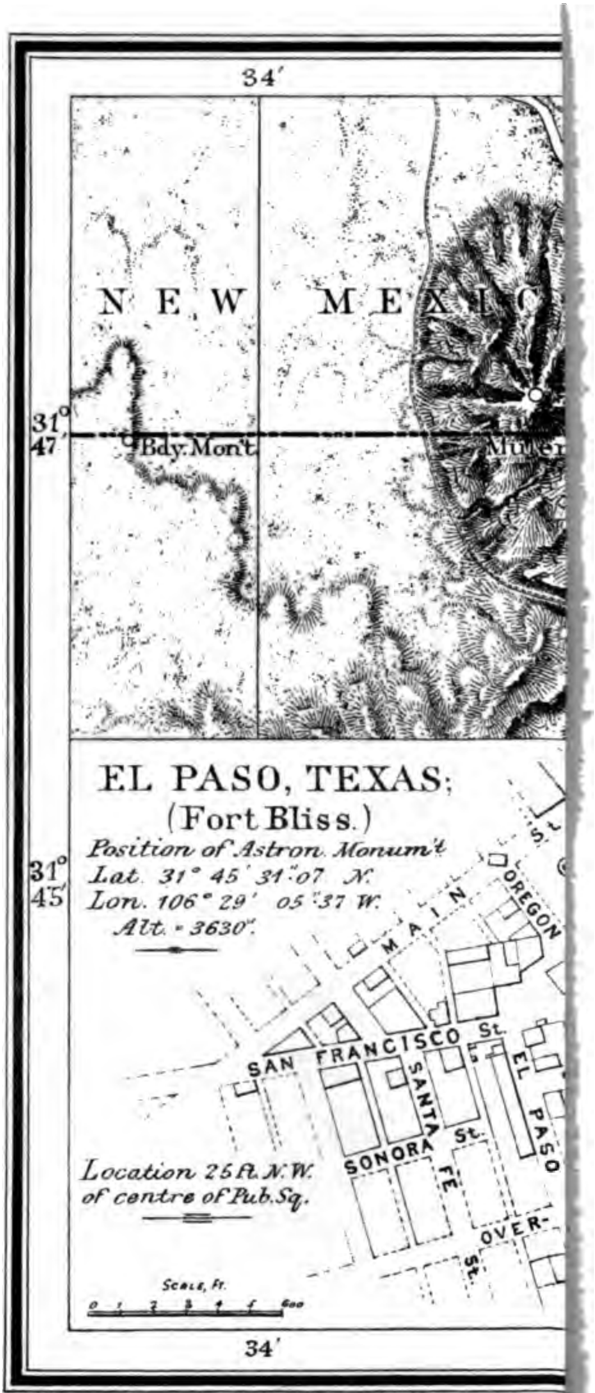

SKETCH of EL PASO, TEXA

Comparison of the two determinations.

Whose determination.	El Paso cathedral (bell-tower).						Boundary monument on right bank of river.					
	Latitude.			Longitude.			Latitude.			Longitude.		
	°	′	″	°	′	″	°	′	″	°	′	″
n Boundary Commission......	31	44	17.68	106	29	0.66	31	47	0.00	106	31	29.20
States geographical survey of 100th meridian............	31	44	14.85	106	28	59.24	31	46	58.28	106	31	33.49

lative position of points see sketch herewith.

accompanying plate shows the positions of the astronomical station of 1878,
Fort Bliss, Tex., of the initial astronomical station of the Mexican Boundary
ission, and also one of its derived positions at Frontera, as well as that of the
ary monument on the west bank of the Rio Grande.

TRONOMICAL STATION AT FORT BAYARD, IN GRANT COUNTY, NEW MEXICO.

Geographical position.

gitude, 108° 09′ 08″.77 west from Greenwich.
itude, 32° 47′ 40″.35 north.
metric altitude of the observatory above sea-level (top of monument, which is
high), 6,097 feet.
monument is situated on the summit of a rounded hill of syenite rock just out-
e quadrangle of the post at its western corner. It bears from the flag-staff in
rade-ground south 69° 24′ 0″, and is 636 feet distant from it, and the top of its
tion is 32 feet above the surface at the flag-staff and 6,094 feet above the level
sea.
monument is built of brick, 18 by 22 inches, on a solid rock foundation, a foot
the surface and 29 inches high above the surface (exclusive of the thickness of
one).

PHYSICAL GEOGRAPHY DETAILS.

Bayard lies at the axis of an anticlinal valley at the backbone of the continent,
by the fracture of the arch of an elevated fold and denudation by weathering
the rims 20 miles apart, on the east the Santa Rita Mountains, and on the
e Burro and Pinos Altos Mountains. At Bayard syenitic rock forms the hills,
nce both eastward and westward newer and newer rocks come successively to
face. Thus, towards the east, schists and gold-bearing slates (at Central City);
tes and copper-bearing sandstones; limestone; quartzite and sandstone; gold-
slate; magnetite and hematite iron ores in massive beds; copper-bearing schists,
ine limestone, and white marble at Santa Rita and Hanover copper mines;
earing limestones (Georgetown); dikes, and superincumbent beds of volcanic
Towards the west there is a similar succession of rocks up to the gold-bearing
s Pinos Altos and the silver-bearing limestones at Silver City.
mountain-trough is diversified by a succession of rounded hills and rolling ridges
es, none of which have flowing water, except the large vale in which Fort
is situated, and a still larger one at the east, Hanover Valley. At some places
tops widen into tables, and at others there are narrow rocky ridges and ravines.
yard lies at the foot of low, round syenite hills, at the head of a vale that opens
ard, and is drained by a rivulet that flows by Central City and in a few miles
nover Brook.
ills and slopes are thinly covered by juniper, pine, and oak trees 20 to 40 feet
raggy and gnarled. There is good pasturage, especially in the long, winding
ere the water drains. The landscape is sweet and restful; with the quiet, green
ight with wild flowers, and vistas of the mountains through the picturesquely
and grouped trees near and deep blue to the north, east, and west, and distant,
ue, and vanishing to the south beyond the hazy plain; the Burro Mountains
west; the Pinos Altos to the northwest; the Black range to the north; Santa
rever kneeling and supplicating at the foot of an inaccessible precipice, to the
e Floridas, grandly high and melting blue, to the southeast; and the Boca
and Hacheta Mountains, over the border in Mexico, far and faint and dreamy.

METEOROLOGICAL CONDITIONS.

During the occupancy of the station, from September 23 to October 11, there were three cloudy days, on October 4, 5, and 6, when there was a little rain, and thunderstorms around the horizon on October 5. All the remaining days the sky was clear and bright, such weather as only a mountain climate affords.

High winds, from 10 to 20 or 25 miles an hour, prevailed, some time in every 24 hours, with intervals of calm and moderate winds. On September 29 and 30 and October 5 the velocity attained 40 to 50 miles an hour, and extra ropes and iron pins had to be used to secure the observatory tent, and by the morning of the 30th four of the ropes had parted. The blowing dust necessitated the taking apart and cleaning of the instrument on October 4. The winds interfered besides with the observations by often blowing the lights out.

Residents say that usually about October 10 a spell of cold, rainy weather sets in here. The bad weather on October 4 to 6 seemed to be a forerunner of it, and, if so, the astronomical observations were finished just in time.

The hourly meteorological observations were made from September 25 to October 11, and afford a very good barometric horary curve, of which the ordinates are as follows:

Hour.	Correction to barom. reading. Inches.	Hour.	Correction to barom. reading. Inches.
7 a. m	−0.018	7 p. m	+0.014
8 a. m	−0.030	8 p. m	+0.006
9 a. m	−0.037	9 p. m	−0.004
10 a. m	−0.036	10 p. m	−0.011
11 a. m	−0.026	11 p. m	−0.009
12 m	−0.007	12 p. m	−0.007
1 p. m	+0.010	1 a. m	−0.002
2 p. m	+0.027	2 a. m	−0.003
3 p. m	+0.033	3 a. m	+0.002
4 p. m	+0.041	4 a. m	+0.004
5 p. m	+0.034	5 a. m	−0.001
6 p. m	+0.023	6 a. m	−0.011

The maximum day temperatures ranged from 70° to 80° F., and the minimum night temperatures from 50° to 60°.

The prevailing winds were from the southwest, west, and northwest; less frequent from northeast, seldom from the east and southeast, and rarely from the north or south.

Day after day the sky was serene, with westerly winds, and only the winds from easterly quarters brought clouds and showers.

The lowest average humidity accompanied a southwest wind, being 0.25 to 0.35; with a northwest wind, 0.45; north, 0.50; northeast, 0.60; east, 0.60 to 0.80; southeast, 0.40; showing a regular increase of humidity and approach towards saturation as the wind veered from southwest by the north to east.

PERSONNEL; OBSERVATORY; TELEGRAPH LINES.

The astronomical observer was Miles Rock, C. E., civilian assistant engineer, and Fred. W. Floyd, E. M., was the assistant and meteorological observer. Dr. August Herbst, an experienced observer, was employed temporarily to assist in the hourly barometric readings.

The observatory was a small wall-tent, with a seam ripped and fastened apart for a meridian opening.

On the first evening Fred. W. Mallory was the telegraph operator, and W. D. McChesney on the other four nights—both enlisted men in the United States Signal Corps. The telegraph wires used from Bayard to San Diego on the western and from Bayard to Santa Fé on the eastern circuit belong to the United States Military Telegraph, under Gen. A. J. Myer; the wires from San Diego, via Oakland, to Ogden, and from Santa Fé, via Pueblo and Cheyenne, to Ogden, belong to the Western Union Telegraph Company.

DESCRIPTION OF INSTRUMENTS USED.

A portable transit by William Würdemann, Washington, marked No. 28, with micrometer-screw and zenith-telescope attachments for latitude observations by Talcott's method, was used. Its focal length is 3 feet; diameter of object-glass, 2¼ inches; diameter of pivots, 1¼ inches; the diagonal eye-piece magnifies 40 diameters. It has two finding circles, attached on opposite sides of the eye end of the tube, 3¼ inches in diameter, graduated to 20′ and reading to 1′ by vernier. Another circle, 6 inches in diameter, and graduated to 20′ and reading to 1′ by vernier, is attached with the latitude zenith-level to the object end of the tube.

The equatorial intervals of the threads from the mean of all 7 is as follows: For clamp east:

1–4	33.31
2–4	12.44
3–4	4.38
4–5	4.02
4–6	12.26
4–7	33.82

The value of a division of the striding level used in the observations here and at Fort Bliss is 1″.05, as determined by Professor Harkness's level-trier at the United States Naval Observatory. The value 62″.1? for one revolution of the micrometer-screw was employed in the reductions, but considered to include refraction. On discussing the results for latitude, a correction +0″.07 for every minute of the micrometer correction was added; this also includes refraction. So that the definitive value of one revolution is 62″.12 + 0.0724 — refraction, or about 62″.17. The value of one division of the zenith-telescope level is 1′.10.

The remaining instruments used were two chronometers: a mean-time chronometer, Hutton No. 288, which was used in exchanging signals, and compared with the sidereal immediately before and after the exchange of signals, and also at the beginning and end of the night's star observations. The local time was determined with a sidereal break-circuit chronometer, Negus No. 1344, and was connected with a single small Le Clanché cell and an ordinary telegraph-sounder to help the observer hear the seconds ticks.

All the observations were made by eye and ear.

The mean-time chronometer was carried to the telegraph office for exchange of signals, a distance of about 400 feet.

POINTS WITH WHICH CONNECTIONS WERE MADE, &C.

Telegraphic connection was made with the engineer observatory at Ogden, Utah, on five nights: September 26 and 30, 1878, and October 1 and 3, by United States military telegraph through Silver City, N. Mex., 9 miles; Phœnix, Ariz., 360 miles; Fort Yuma, Cal., 200 miles, to San Diego, Cal., 175 miles; thence by lines of the Western Union Company through Los Angeles, 125 miles; San Francisco (Oakland), 450; to Ogden, 830, altogether about 2,150 miles. The signals were automatically repeated at Silver City, Phœnix, and San Diego.

On September 27 the connection was made by the United States military telegraph through Mesilla, 100 miles; Santa Fé, 300; Pueblo, 300; Denver, 125; Cheyenne, 110; to Ogden, 515, altogether about 1,450 miles. The signals were automatically repeated at Santa Fé, N. Mex.

On some nights, by the longer circuit, the impulses arrived so weak that the relay on the main line could not open the local circuit, and the signals had to be read by the faint click of the relay armature. This way is preferable whenever it is quiet enough to hear, as the click is sharp and it reduces the automatic repetitions by one.

The observations were computed and arranged, as they follow, by Professor T. H. Safford.

Tabulation of stars used for determination of time at Ogden, Utah, and Fort Bayard, N. Mex.

Name of star.	Ogden, Utah.					Fort Bayard, N. Mex.				
	September 26.	September 27.	September 30.	October 1.	October 3.	September 26.	September 27.	September 30.	October 1.	October 3.
50 Draconis	×	......	......	......	......	......	......	......	......	......
γ Lyræ	×	......	......	......	......	......	......	......	......	......
ζ Aquilæ	×	......	......	......	......	......	......	......	......	......
ε Lyræ	×	......	......	......	......	......	......	......	......	......
19 Lyræ	×	......	......	......	......	......	......	......	......	......
δ Draconis	×	......	......	......	......	......	......	......	......	......
ι Cygni	......	......	......	×		......	......	......	......	......
φ Cygni		×	......	×		......	......	......	......	......
28 Heis Cygni			×	×		......	......	......	......	......
δ Sagittæ			×	×	×	......	......	......	......	......
12 Vulpeculæ			×	......	......	......	......	......	......	......
Draconis			......	×	×	......	......	......	......	......
γ Sagittæ			......	......	......	......	......	......	......	......
15 Vulpeculæ	......	......	×	......	......	......	......	......	......	......
Sagittæ	......	......	×	......	......	......	......	......	......	......
Aquilæ	......	......	......	×	×	......	......	......	......	......
Cephei	......	×	×	×	×	......	......	......	......	......

Tabulation of stars used for determination of time at Ogden, Utah, &c.—**Continued.**

Name of star.	Ogden, Utah.					Fort Bayard, N. Mex.				
	September 26.	September 27.	September 30.	October 1.	October 3.	September 26.	September 27.	September 30.	October 1.	October 3.
γ Cygni	.....	×	.....	.....	.....	.....	.....	.....	.....	.....
39 Cygni	.....	.....	.....	×	×	.....	.....	.....	.....	.....
40 Cygni	.....	×	.....	.....	.....	.....	.....	.....	.....	.....
41 Cygni	.....	.....	.....	×	×	.....	.....	.....	.....	.....
ε Delphini	.....	×	×	×	×	.....	.....	.....	.....	.....
Groombr. 3241	.....	.....	.....	.....	.....	×	.....	.....	.....	.....
73 Draconis	.....	×	×	×	×	.....	.....	.....	.....	.....
α Delphini	.....	.....	.....	.....	.....	×	.....	.....	.....	.....
α Cygni	.....	.....	.....	.....	.....	×	.....	.....	.....	.....
Pi. xx, 283	.....	×	.....	.....	.....	.....	.....	.....	.....	.....
ε Cygni	.....	.....	×	.....	.....	×	.....	.....	.....	.....
μ Aquarii	.....	.....	.....	.....	.....	×	.....	.....	.....	.....
Pi. xx, 358	.....	.....	×	.....	.....	.....	.....	.....	.....	.....
32 Vulpeculæ	.....	.....	×	.....	.....	.....	.....	.....	.....	.....
Br. 2749	.....	.....	×	.....	.....	×	.....	.....	.....	.....
61 Cygni	.....	.....	.....	.....	.....	×	.....	.....	.....	.....
ζ Cygni	.....	.....	.....	.....	.....	×	.....	.....	.....	.....
τ Cygni	.....	.....	.....	.....	.....	×	×	×	×	×
α Cephei	.....	.....	.....	.....	.....	×	.....	.....	.....	.....
1 Pegasi	.....	.....	.....	.....	.....	.....	×	×	×	×
1 H. Draconis s. p	.....	.....	.....	.....	.....	×	×	×	×	×
β Cephei	.....	.....	.....	.....	.....	.....	×	×	×	×
74 Cygni	.....	.....	.....	.....	.....	.....	×	×	×	×
ε Pagasi	.....	.....	.....	.....	.....	.....	×	×	×	×
π² Cygni	.....	.....	.....	.....	.....	.....	×	×	×	×
16 Pegasi	.....	.....	.....	.....	.....	.....	×	×	×	×
79 Draconis	.....	.....	.....	.....	.....	.....	×	×	×	×
α Aquarii	.....	.....	.....	.....	.....	.....	×	×	×	×
27 Pegasi	.....	.....	.....	.....	.....	.....	.....	×	.....	×
π Pegasi	.....	.....	.....	.....	.....	.....	.....	.....	×	×
226 Cephei B	.....	×	.....	.....	.....	.....	.....	.....	.....	.....
η Pegasi	×	.....	.....	.....	.....	.....	.....	.....	.....	.....
λ Pegasi	×	.....	.....	.....	.....	.....	.....	.....	.....	.....
μ Pegasi	.....	×	.....	.....	.....	.....	.....	.....	.....	.....
ι Cephei	×	.....	.....	.....	×	.....	.....	.....	.....	.....
B. A. C. 7984	.....	×	.....	.....	.....	.....	.....	.....	.....	.....
Pi. xxii, 261	.....	×	.....	.....	.....	.....	.....	.....	.....	.....
β Pegasi	×	×	.....	.....	×	.....	.....	.....	.....	.....
56 Pegasi	×	×	.....	.....	×	.....	.....	.....	.....	.....
π Cephei	×	×	.....	.....	.....	.....	.....	.....	.....	.....
Pi. xxiii	.....	.....	.....	.....	×	.....	.....	.....	.....	.....
ο Cephei	.....	.....	.....	.....	×	×	×	.....	.....	.....
τ Pegasi	.....	×	.....	×	.....	×	×	.....	.....	.....
υ Pegasi	.....	×	.....	×	.....	.....	.....	.....	.....	.....
70 Pegasi	.....	×	.....	.....	.....	.....	.....	.....	.....	.....
λ Draconis s. p	.....	.....	.....	.....	.....	×	×	.....	.....	×
72 Pegasi	.....	×	×	×	×	.....	.....	.....	.....	.....
153 Heis Pegasi	.....	.....	.....	×	.....	.....	.....	.....	.....	.....
λ Andromedæ	.....	.....	.....	.....	.....	×	×	.....	.....	×
ι Piscium	.....	.....	.....	.....	.....	×	×	.....	.....	×
γ Cephei	.....	.....	×	×	×	.....	.....	.....	.....	×
78 Pegasi	.....	.....	.....	.....	×	.....	.....	.....	.....	.....
41 H. Cephei	.....	.....	.....	×	.....	.....	.....	.....	.....	.....
79 Pegasi	.....	.....	.....	.....	×	.....	.....	.....	.....	.....
φ Pegasi	.....	.....	.....	.....	×	.....	.....	.....	.....	.....
Groombr. 4163	.....	.....	.....	.....	.....	×	×	.....	.....	×
ψ Pegasi	.....	.....	.....	×	.....	.....	.....	.....	.....	.....
ω Piscium	.....	.....	.....	.....	.....	.....	×	.....	×	×
85 Pegasi	.....	.....	.....	×	.....	.....	.....	.....	.....	.....
α Andromedæ	.....	.....	×	×	.....	×	×	×	×	×
22 Andromedæ	.....	.....	.....	.....	.....	.....	.....	.....	×	×
4 H. Draconis, s. p	.....	.....	.....	.....	.....	.....	.....	×	.....	.....
γ Pegasi	.....	.....	×	×	.....	×	×	.....	×	×
ι Ceti	.....	.....	.....	.....	.....	.....	.....	×	.....	.....
6 B. Ursæ Minoris s. p	.....	.....	.....	.....	.....	×	×	.....	×	×
12 Ceti	.....	.....	.....	.....	.....	×	.....	×	×	×
π Andromedræ	.....	.....	.....	.....	.....	×	.....	×	×	×
21 Cassiopeiæ	.....	.....	.....	.....	.....	.....	.....	×	×	.....
δ Piscium	.....	.....	.....	.....	.....	.....	.....	×	×	.....
32 H. Camelopard. s. p	.....	.....	.....	.....	.....	.....	.....	.....	×	.....
μ Andromedæ	.....	.....	.....	.....	.....	.....	.....	×	.....	.....
ε Piscium	.....	.....	.....	.....	.....	.....	.....	×	.....	.....
β Andromedæ	.....	.....	.....	.....	.....	.....	.....	×	.....	.....
Polaris	.....	.....	.....	.....	.....	.....	.....	×	.....	.....

Name of star.	Clamp.	T.			Bb.	Aa.	Cc.	T'.			A. R.			Δ T.	
		h.	*m.*	*s.*	*s.*	*s.*	*s.*	*h.*	*m.*	*s.*	*h.*	*m.*	*s.*	*m.*	*s.*
Gr. 3241	W.	20	38	55.37	− 0.09	− 4.13	− 0.72	20	38	50.43	20	30	32.65	− 8	17.78
α Delphini	W.		43	19.11	− 0.04	+ 0.62	− 0.23		43	19.46	20	34	01.69	8	17.77
α Cygni	W.		45	38.26	− 0.05	− 0.59	− 0.31		45	37.31	20	37	19.18	8	18.13
τ Cygni	W.		49	38.33	− 0.04	− 0.03	− 0.27		49	37.99	20	41	19.62	8	18.37
μ Aquarii	W.	20	54	25.53	− 0.03	+ 1.36	− 0.23	20	54	26.63	20	46	08.40	8	18.23
Brdl. 2749	W.	21	01	33.94	− 0.14	− 8.54	− 1.29	21	01	23.97	20	53	04.53	8	19.44
61 Cygni	E.		09	47.53	− 0.04	− 0.24	+ 0.28		09	47.53	21	01	29.08	8	18.45
ζ Cygni	E.		16	06.08	− 0.04	+ 0.12	+ 0.26		16	06.42	21	07	47.98	8	18.44
τ Cygni	E.		18	16.80	− 0.04	− 0.21	+ 0.28		18	16.83	21	09	58.51	8	18.32
α Cephei	E.		24	02.75	− 0.06	− 2.09	+ 0.47		24	01.07	21	15	42.69	8	18.88
1 H. Draconis	E.	21	27	46.25	+ 0.10	+ 12.81	− 1.57	21	27	57.59	21	19	38.08	− 8	19.51

NORMAL EQUATIONS.

$a_0 = +1^s.8 \qquad c_0 = +0^s.25 \qquad \Delta T_0 = -8^m\ 18^s.25 \text{ for } 21^h.0$

$$\begin{aligned}
&\quad\ \ s.\\
0 &= +0.389 + 7.13\, d\Delta T - 0.40\, da - 1.40\, dc.\\
0 &= -1.469 - 0.40\, d\Delta T + 7.14\, da - 1.22\, dc.\\
0 &= +0.757 - 1.40\, d\Delta T - 1.22\, da + 20.87\, dc.
\end{aligned}$$

$$\begin{array}{llll}
 & & m. & s. \\
d\Delta T = -0.048 & \Delta T = -8 & & 18.298\ (\text{wt.} = 7.02) \\
da = +0.198 & a = + & & 1.998\ (\text{wt.} = 7.04 \\
dc = -0.028 & c = + & & 0.222\ (\text{wt.} = 20.36)
\end{array}$$

Fort Bayard, September 26, 1878; after signals.

Name of star.	Clamp.	T.	Bb.	Ac.	Cc.	T′.	A. R.	ΔT.
		h. m. s.	s.	s.	s.	h. m. s.	h. m. s.	m. s.
ο Cephei	E.	23 22 02.95	− 0.14	− 2.55	+ 0.49	23 22 00.75	23 13 41.74	− 8 19.01
τ Pegasi	E.	22 53.34	− 0.07	+ 0.32	+ 0.20	22 53.79	23 14 35.05	8 18.74
λ Draconis S. P	E.	32 24.06	+ 0.04	+ 4.91	− 0.54	32 28.47	23 24 09.86	8 18.61
λ Andromedæ	E.	39 58.97	− 0.09	− 0.56	+ 0.27	39 58.59	23 31 40.05	8 18.54
ι Piscium	E.	42 02.28	− 0.06	+ 0.81	+ 0.19	42 3.22	23 33 44.77	8 18.45
Groombr. 4163	W.	23 57 24.14	+ 0.05	− 4.63	− 0.06	23 57 19.50	23 49 00.51	8 18.99
α Andromedæ	W.	0 10 27.93	+ 0.02	+ 0.15	− 0.21	0 10 27.89	0 02 09.26	8 18.63
γ Pegasi	W.	15 19.70	+ 0.02	+ 0.56	− 0.19	15 20.09	0 07 01.51	8 18.58
δ B. Ursæ Minoris S. P	W.	21 18.04	− 0.33	+51.81	+ 6.54	22 16.06	0 13 50.71	8 25.35
12 Ceti	W.	32 11.08	+ 0.01	+ 1.05	− 0.19	32 11.95	0 23 53.07	8 18.88
π Andromedæ	W.	0 38 45.55	+ 0.02	− 0.01	− 0.22	0 38 45.34	0 30 26.44	− 8 18.90

NORMAL EQUATIONS.

$a_0 = +1^s.8 \qquad c_0 = +0^s.25 \qquad \Delta T_0 = -8^m.18^s.70$ for $0^h.0$.

$$\begin{aligned} & \quad\ s. \\ 0 &= -0.009 + 6.99\,d\Delta T + 1.27\,da - 2.09\,dc. \\ 0 &= +0.559 + 1.27\,d\Delta T + 7.43\,da - 0.44\,dc. \\ 0 &= +1.132 - 2.09\,d\Delta T - 0.44\,da + 18.42\,dc. \end{aligned}$$

$$\begin{aligned} d\Delta T &= -0.004^s & \Delta T &= -8^m\ 18^s.704\ (\text{wt.} = 6.52.) \\ da &= -0.078 & a &= +\ 1.722\ (\text{wt.} = 7.29.) \\ dc &= -0.064 & c &= +\ 0.186\ (\text{wt.} = 17.79.) \end{aligned}$$

Fort Bayard, September 27, 1878; before signals.

Name of stars.	Clamp.	T.	Bb.	Aa.	Cc.	T′.	A.R.	ΔT.
		h. m. s.	s.	s.	s.	h. m. s.	h. m. s.	m. s.
τ Cygni	W.	21 18 19.45	− 0.11	+ 0.01	− 0.37	21 18 18.98	21 09 58.50	− 8 20.48
1 Pegasi	W.	24 51.00	− 0.09	− 0.02	− 0.31	24 50.58	21 16 30.20	8 20.38
1 H. Draconis S. P.	W.	27 57.02	+ 0.27	− 0.56	+ 2.05	27 58.78	21 19 38.21	8 20.57
β Cephei	W.	35 28.49	− 0.21	+ 0.15	− 0.85	35 27.58	21 27 07.36	8 20.22
74 Cygni	W.	40 27.70	− 0.12	+ 0.01	− 0.38	40 27.21	21 32 06.90	8 20.31
ε Pegasi	E.	46 35.45	− 0.13	− 0.04	+ 0.29	46 35.57	21 38 15.48	8 20.09
π² Cygni	E.	50 40.59	− 0.21	+ 0.04	+ 0.44	50 40.86	21 42 20.49	8 20.37
16 Pegasi	E.	55 54.54	− 0.15	− 0.01	+ 0.32	55 54.70	21 47 34.33	8 20.37
79 Draconis	E.	21 59 43.48	− 0.37	+ 0.19	+ 1.00	21 59 44.25	21 51 23.75	8 20.50
α Aquarii	E.	22 07 55.31	− 0.12	− 0.05	+ 0.29	22 07 55.43	21 59 35.12	8 20.31

NORMAL EQUATIONS.

$a_0 = -0^s.20 \qquad c_0 = +0^s.25 \qquad \Delta T_0 = -8^m.\ 20^s.35 \text{ for } 21^h.7$

$$\begin{aligned}
&s.\\
0 &= -0.202 + 7.06\, d\Delta T + 0.21\, da + 1.38\, dc.\\
0 &= -0.883 + 0.21\, d\Delta T + 6.23\, da + 4.31\, dc.\\
0 &= -1.258 + 1.38\, d\Delta T + 4.31\, da + 18.48\, dc.
\end{aligned}$$

$$\begin{aligned}
&\quad s. & &\quad m.\ \ s.\\
d\Delta T &= +0.017 & \Delta T &= -8\ 20.333\ (\text{wt.} = 6.96.)\\
da &= +0.113 & a &= -\ \ 0.087\ (\text{wt.} = 5.22.)\\
dc &= +0.040 & c &= +\ \ 0.290\ (\text{wt.} = 15.29.)
\end{aligned}$$

Fort Bayard, September 27, 1878; after signals.

Name of star.	Clamp.	T.	Bb.	Aa.	Cc.	T'.	A. R.	Δ T.
		h. m. s.	s.	s.	s.	h. m. s.	h. m. s.	m. s.
ο Cephei	E.	23 22 2.02	− 0.27	+ 0.48	+ 0.71	23 22 2.94	23 13 41.73	− 8 21.21
τ Pegasi	E.	23 0.46	− 0.13	− 0.06	+ 0.30	23 0.57	23 14 40.05	8 20.52
λ Draconis, S. P	E.	32 32.33	+ 0.08	− 0.92	− 0.80	32 30.69	23 24 09.88	8 20.81
λ Andromedæ	E.	40 0.20	− 0.17	+ 0.13	+ 0.39	40 00.55	23 31 40.05	8 20.50
ι Piscium	E.	42 5.24	− 0.11	− 0.15	+ 0.28	42 05.26	23 33 44.78	8 20.48
Grombr. 4163	W.	23 57 21.97	− 0.32	+ 0.75	− 0.98	23 57 21.42	23 49 00.50	8 20.92
ω Piscium	W.	0 1 28.11	− 0.11	− 0.14	− 0.28	0 01 27.58	23 53 07.06	8 20.52
α Andromedæ	W.	10 30.17	− 0.13	− 0.03	− 0.31	10 29.70	0 02 09.26	8 20.44
γ Pegasi	W.	15 22.47	− 0.12	− 0.10	− 0.28	15 21.97	0 07 01.52	8 20.45
δ B. Ursæ Minoris, S. P	W.	22 11.09	+ 2.10	− 9.63	+ 9.64	22 13.20	0 13 50.70	8 22.50
δ B. Ursæ Minoris, S. P	E.	0 22 33.12	+ 2.83	− 9.63	− 9.64	0 22 16.68	0 13 50.70	− 8 25.98

NORMAL EQUATIONS.

$a_0 = -0^s.2 \qquad c_0 = +0^s.25 \qquad \Delta T_0 = -8^m\ 20^s.50 \text{ for } 0^h.0$

$$\begin{aligned}
&\;\;\; s. \\
0 &= +0.706 + 6.87\ d\Delta T + 1.14\ da - 1.21\ dc \\
0 &= +1.372 + 1.14\ d\Delta T + 9.99\ da - 2.89\ dc \\
0 &= -0.971 - 1.21\ d\Delta T - 2.89\ da + 22.15\ dc
\end{aligned}$$

$$\begin{aligned}
&\;\;\; s. && \quad m.\ \ s. \\
d\Delta T &= -0.079 & \Delta T &= -8\ \ 20.579\ (\text{wt.} = 6.70) \\
da &= -0.122 & a &= -\ \ 0.322\ (\text{wt.} = 9.47) \\
dc &= +0.024 & c &= +\ \ 0.274\ (\text{wt.} = 21.28)
\end{aligned}$$

[illegible]

Name of star.	Clamp.	T.	b B.	a A.	c C.	T'.	A. R.	Δ T.
		h. m. s.	s.	s.	s.	h. m. s.	h. m. s.	m. s.
τ Cygni	E.	21 18 22.39	− 0.05	− 0.02	+ 0.19	21 18 22.51	21 09 58.45	− 8 24.06
1 Pegasi	E.	24 54.08	− 0.05	+ 0.03	+ 0.17	24 54.23	21 16 30.17	8 24.06
1 H. Draconis, s. p	E.	28 03.04	+ 0.13	+ 1.14	− 1.00	28 03.22	21 19 38.61	8 24.61
β Cephei	E.	35 31.47	− 0.10	− 0.32	+ 0.45	35 31.50	21 27 07.23	8 24.27
74 Cygni	E.	40 30.83	+ 0.06	− 0.03	+ 0.20	40 31.06	21 32 06.86	8 24.20
ε Pegasi	W.	46 39.52	+ 0.03	+ 0.07	− 0.16	46 39.46	21 38 15.45	8 24.01
π² Cygni	W.	50 44.90	+ 0.04	− 0.07	− 0.23	50 44.64	21 42 20.44	8 24.20
16 Pegasi	W.	55 58.47	+ 0.03	+ 0.03	− 0.17	55 58.36	21 47 34.30	8 24.06
79 Draconis	W.	21 59 48.50	+ 0.07	− 0.40	− 0.53	21 59 47.73	21 51 23.62	8 24.11
α Aquarii	W.	22 07 59.12	+ 0.02	+ 0.10	− 0.15	22 07 59.09	21 50 35.10	8 23.99
27 Pegasi	W.	22 12 17.30	+ 0.03	0.00	− 0.18	22 12 17.15	22 03 52.95	− 8 24.20

NORMAL EQUATIONS.

$$a_0 = 0 \quad c_0 = +\,0^s.25 \quad \Delta T_0 = -\,8^m\ 24.^s10 \text{ for } 21^h.8$$

$$\begin{aligned} & \quad\ \ s. \\ 0 &= -\,0.198 + 8.05\,d\,\Delta T + 0.02\,d\,a - 2.54\,dc \\ 0 &= -\,1.567 + 0.02\,d\,\Delta T + 6.63\,d\,a - 4.06\,dc \\ 0 &= +\,2.690 - 2.54\,d\,\Delta T - 4.06\,d\,a + 20.75\,dc \end{aligned}$$

$$\begin{aligned} & \quad\ \ s. & & \quad m.\ s. \\ d\,\Delta T &= -\,0.006 & \Delta T &= -\,8\ 24.106 \ (\text{wt.} = 7.70) \\ d\,a &= +\,0.178 & a &= +\ \ 0.178 \ (\text{wt.} = 5.81) \\ d\,c &= -\,0.096 & c &= +\ \ 0.154 \ (\text{wt.} = 17.47) \end{aligned}$$

Fort Bayard, September 30, 1878; after signals.

Name of star.	Clamp.	T.			B*b*.	A*a*.	C*c*.	T'.			A. R.			I	
		h.	*m.*	*s.*	*s.*	*s.*	*s.*	*h.*	*m.*	*s.*	*h.*	*m.*	*s.*	*m.*	*s.*
α Andromedæ	W.	0	10	33.47	+ 0.03	0.00	− 0.13	0	10	33.37	0	02	09.28	− 8	24.09
4 H. Draconis, s. p.	W.		14	50.51	− 0.04	+ 0.17	+ 0.57		14	51.21	0	06	26.62	8	24.59
ι Ceti	W.		21	41.60	+ 0.02	+ 0.03	− 0.12		21	41.53	0	13	17.08	8	24.45
12 Ceti	W.		32	17.55	+ 0.02	+ 0.02	− 0.12		32	17.47	0	23	53.10	8	24.37
π Andromedæ	W.		38	51.08	+ 0.03	0.00	− 0.14		38	50.97	0	30	26.47	8	24.50
21 Cassiopeiæ	W.		46	09.44	+ 0.06	− 0.09	− 0.43		46	8.98	0	37	44.25	8	24.73
δ Piscium	E.		50	49.81	+ 0.02	+ 0.02	+ 0.12		50	49.97	0	42	25.52	8	24.45
μ Andromedæ	E.	0	58	28.02	+ 0.03	0.00	+ 0.15	0	58	28.20	0	50	03.76	8	24.44
ε Piscium	E.	1	05	05.32	+ 0.02	+ 0.02	+ 0.12	1	05	5.48	0	56	41.05	8	24.43
β Andromedæ	E.		11	23.07	+ 0.03	0.00	+ 0.14		11	23.24	1	02	58.87		
Polaris	E.	1	23	19.56	+ 0.50	− 1.35	+ 4.95	1	23	23.66	1	14	59.94	− 8	23.72

NORMAL EQUATIONS.

$a_0 = 0 \qquad c_0 = +0^s.25 \qquad \Delta T_0 = -8^m.24^s.40 \text{ for } 0^h.7$

$$\begin{aligned} &\quad\ \ {}^{s.} \\ 0 &= -0.015 + 7.93\ d\Delta T + 2.11\ da + 0.08\ dc \\ 0 &= -0.112 + 2.11\ d\Delta T + 9.04\ da + 1.63\ dc \\ 0 &= +2.734 + 0.08\ d\Delta T + 1.63\ da + 20.82\ dc \end{aligned}$$

$$\begin{aligned} & \quad\ {}^{s.} & & \quad\ {}^{m.}\quad {}^{s.} \\ d\Delta T &= -0.007 & \Delta T &= -8\ \ 24.407\ (\text{wt.} = 7.44) \\ da &= +0.038 & a &= +\ \ 0.038\ (\text{wt.} = 8.35) \\ dc &= -0.134 & c &= +\ \ 0.116\ (\text{wt.} = 20.51) \end{aligned}$$

Fort Bayard, October 1, 1878; before signals.

Name of star.	Clamp.	T.	Bb.	A a.	Cc.	T'.	A. R.	Δ T.
		h. m. s.	s.	s.	s.	h. m. s.	h. m. s.	m. s.
τ Cygni	E.	21 18 24.67	− 0.25	0.00	+ 0.34	21 18 24.76	21 09 58.43	− 8 26.33
7 Pegasi	E.	24 55.89	− 0 20	0.00	+ 0.29	24 55.98	21 16 30.15	8 25.83
1 H. Draconis, s. p	E.	28 06.82	+ 0.59	− 0.09	− 1.93	28 05.39	21 19 38.75	8 26.64
β Cephei	E.	35 32.71	− 0.46	+ 0.03	+ 0.80	35 33.08	21 27 07.18	8 25.90
74 Cygni	E.	40 32.73	− 0.25	0.00	+ 0.36	40 32.84	21 32 06.83	8 26.01
ε Pegasi	W.	46 41.58	− 0.15	− 0.01	− 0.28	46 41.14	21 38 15.44	8 25.70
π² Cygni	W.	50 47.20	− 0.24	+ 0.01	− 0.41	50 46.56	21 42 20.42	8 26.14
16 Pegasi	W.	56 00.57	− 0.18	0.00	− 0.30	56 00.09	21 47 34.29	8 25.80
79 Draconis	W.	21 59 50.97	− 0.43	+ 0.03	− 0.94	21 59 49.63	21 51 23.57	8 26.06
α Aquarii	W.	22 08 01.38	− 0.14	− 0.01	− 0.27	22 08 00.96	21 59 35.09	8 25.87
π Pegasi	W.	22 13 04.37	− 0.19	0.00	− 0.32	22 13 03.86	22 04 37.80	− 8 26.06

NORMAL EQUATIONS.

$a_0 = -0^s.20 \qquad c_0 = +0^s.25 \qquad \Delta T_0 = -8^m\ 26^s.00$ for $21^h.8$

$$\begin{aligned} &\text{s.} \\ 0 &= -0.232 + 7.95\ d\Delta T - 0.03\ da - 2.44\ dc \\ 0 &= -1.095 - 0.03\ d\Delta T + 6.60\ da - 4.00\ dc \\ 0 &= +0.342 - 2.44\ d\Delta T - 4.00\ da + 20.65\ dc \end{aligned}$$

$$\begin{array}{lll} & & \text{m.}\quad \text{s.} \\ d\Delta T = +0.037 & \Delta T = - & 8\quad 25.963\ (\text{wt.} = 7.62) \\ da = +0.180 & a = - & \quad\ \ 0.020\ (\text{wt.} = 5.80) \\ dc = +0.023 & c = + & \quad\ \ 0.273\ (\text{wt.} = 17.47) \end{array}$$

Fort Bayard, October 1, 1878; after signals.

Name of star.	Clamp.	T.	B*b*.	A*a*.	C*c*.	T′.	A. R.	ΔT.
		h. m. s.	*s.*	*s.*	*s.*	*h. m. s.*	*h. m. s.*	*m. s.*
ω Piscium	W.	0 01 33.43	− 0.11	− 0.10	− 0.32	0 01 32.90	23 53 07.07	− 8 25.83
α Andromedæ	W.	10 35.90	− 0.14	− 0.02	− 0.36	10 35.38	0 02 09.28	8 26.10
22 Andromedæ	W.	12 30.20	− 0.17	+ 0.07	− 0.45	12 29.65	0 04 03.50	8 26.15
γ Pegasi	W.	15 27.96	− 0.12	− 0.07	− 0.33	15 27.44	0 07 01.53	8 25.91
6 B. Ursæ Minoris, s. p	W.	22 09.81	+ 2.26	− 6.35	+ 11.11	22 16.83	0 13 50.66	8 26.17
12 Ceti	E.	32 19.04	− 0.11	− 0.13	+ 0.32	32 19.12	0 23 53.11	8 26.01
π Andromedæ	E.	38 52.25	− 0.16	0.00	+ 0.38	38 52.47	0 30 26.48	8 25.99
21 Cassiopeiæ	E.	46 08.94	− 0.37	+ 0.52	+ 1.17	46 10.26	0 37 44.26	8 26.00
δ Piscium	E.	50 51.52	− 0.12	− 0.09	+ 0.32	50 51.63	0 42 25.53	8 26.10
32 H. Camelop., s. p	E.	0 56 37.98	+ 0.59	− 1.82	− 3.06	0 56 33.69	0 48 07.45	− 8 26.24

NORMAL EQUATIONS.

$a_0 = -0^s.20 \qquad c_0 = +0^s.25 \qquad \Delta T_0 = -8^m\ 26^s.00 \text{ for } 0^h.5$

$$\begin{aligned} &\quad s. \\ 0 &= +0.120 + 6.94\, d\Delta T + 1.47\, da - 0.50\, dc \\ 0 &= +0.248 + 1.47\, d\Delta T + 8.01\, da - 2.18\, dc \\ 0 &= -1.285 - 0.50\, d\Delta T - 2.18\, da + 18.94\, dc \end{aligned}$$

$$\begin{aligned} d\Delta T &= -0.010^s & \Delta T &= -8^m\ 26^s.010 \text{ (wt.} = 6.67) \\ da &= -0.011 & a &= -\ 0.211 \text{ (wt.} = 7.46) \\ dc &= +0.066 & c &= +\ 0.316 \text{ (wt.} = 18.34) \end{aligned}$$

Fort Bayard, October 3, 1878; before signals.

Name of star.	Clamp.	T.	Bb.	Aa.	Cc.	T′.	A. R.	ΔT.
		h. m. s.	*s.*	*s.*	*s.*	*h. m. s.*	*h. m. s.*	*m. s.*
τ Cygni	E.	21 18 27.13	− 0.06	+ 0.03	+ 0.42	21 18 27.52	21 09 58.89	− 8 29.18
1 Pegasi	E.	21 24 58.85	− 0.05	− 0.06	+ 0.35	24 59.09	21 16 30.18	8 28.96
1 H. Draconis, s. p	E.	21 28 11.94	+ 0.14	− 1.61	− 2.34	28 08.13	21 19 39.02	8 29.11
β Cephei	E.	21 35 35.01	− 0.11	+ 0.44	+ 0.97	35 36.31	21 27 07.09	8 29.22
7 Cygni	E.	21 40 35.65	− 0.06	+ 0.04	+ 0.43	40 36.06	21 32 06.81	8 29.25
θ Pegasi	W.	21 46 45.04	+ 0.01	− 0.10	− 0.34	46 44.61	21 38 15.42	8 29.19
π² Cygni	W.	21 50 50.15	+ 0.01	+ 0.10	− 0.50	50 49.76	21 42 20.89	8 29.37
16 Pegasi	W.	21 56 03.71	+ 0.01	− 0.04	− 0.37	56 03.31	21 47 34.27	8 29.04
79 Draconis	W.	21 59 52.81	+ 0.02	+ 0.56	− 1.14	21 59 52.25	21 51 23.47	8 28.78
α Aquarii	W.	22 08 04.62	+ 0.01	− 0.14	− 0.33	22 08 04.16	21 59 35.08	8 29.08
27 Pegasi	W.	22 12 22.63	+ 0.01	0.00	− 0.39	12 22.25	22 03 52.92	8 29.33
π Pegasi	W.	22 13 07.37	+ 0.01	0.00	− 0.39	22 18 06.99	22 04 37.78	− 8 29.21

NORMAL EQUATIONS.

$a_0 = -0^s.20 \qquad c_0 = +0^s.25 \qquad \Delta T_0 = -8^m\ 29^s.10$ for $21^h.8$

$$\begin{aligned} &\overset{s.}{} \\ 0 &= +0.804 + 8.98\ d\Delta T - 0.19\ da - 3.53\ dc \\ 0 &= +0.670 - 0.19\ d\Delta T + 6.73\ da - 4.16\ dc \\ 0 &= -2.254 - 3.53\ d\Delta T - 4.16\ da + 27.43\ dc \end{aligned}$$

$$\begin{aligned} d\Delta T &= \overset{s.}{-0.058} & \Delta T &= \overset{m.}{-8}\ \overset{s.}{29.158}\ (\text{wt.} = 8.30) \\ da &= -0.051 & a &= -\ 0.251\ (\text{wt.} = 5.87) \\ dc &= +0.062 & c &= +\ 0.832\ (\text{wt.} = 18.37) \end{aligned}$$

Fort Bayard, October 3, 1878; after signals.

Name of star.	Clamp.	T.			B*b*.	A*a*.	C*c*.	T'.			A. R.			ΔT.	
		h.	*m.*	*s.*	*s.*	*s.*	*s.*	*h.*	*m.*	*s.*	*h.*	*m.*	*s.*	*m.*	*s.*
λ Draconis, s. p	W.	23	32	38.65	−0.02	−0.49	+ 1.15	23	32	39.29	23	24	10.03	− 8	29.26
λ Andromedæ	W.		40	09.72	+0.04	+0.06	− 0.57		40	09.25	23	31	40.04	8	29.21
ι Piscium	W.		42	14.38	+0.03	−0.08	− 0.40		42	13.93	23	33	44.78	8	29.15
γ Cephei	W.		42	57.43	+0.10	+0.53	− 1.75		42	56.31	23	34	27.08	8	29.23
Groom, 4163	W.	23	57	30.75	+0.09	+0.40	− 1.41	23	57	29.83	23	49	00.47	8	29.36
ω Piscium	W.	0	01	36.68	+0.03	−0.08	− 0.40	0	01	36.23	23	53	07.08	8	29.15
α Andromedæ	E.		10	38.21	−0.15	−0.01	+ 0.45		10	38.50	0	02	09.29	8	29.21
22 Andromedæ	E.		12	32.41	−0.19	+0.05	+ 0.56		12	32.83	0	04	03.51	8	29.32
γ Pegasi	E.		15	30.52	−0.13	−0.06	+ 0.41		15	30.74	0	07	01.54	8	29.20
6 B. Ursæ Minoris, s. p	E.		22	37.99	+2.44	−5.14	−13.86		22	21.43	0	13	50.86	8	30.57
12 Ceti	E.		32	22.24	−0.11	−0.10	+ 0.40		32	22.43	0	23	53.12	8	29.31
π Andromedæ	E.	0	38	55.35	−0.16	0.00	+ 0.47	0	38	55.66	0	30	26.49	− 8	29.17

NORMAL EQUATIONS.

$a_0 = -0^s.20 \qquad c_0 = +0^s.35 \qquad \Delta T_0 = -8^m\ 29^s.30$ for $0^h.0$

$$
\begin{aligned}
&\quad\ \ s.\\
0 &= -0.044 + 8.35\,d\Delta T + 1.42\,da + 1.32\,dc\\
0 &= -0.917 + 1.42\,d\Delta T + 9.63\,da + 4.68\,dc\\
0 &= -3.457 + 1.32\,d\Delta T + 4.68\,da + 23.30\,dc
\end{aligned}
$$

$$
\begin{aligned}
& \qquad\quad s. & & \qquad\quad m.\quad s.\\
d\Delta T &= -0.022 & \Delta T &= -8\ 29.222\ (\text{wt.} = 8.12)\\
da &= +0.029 & a &= -\ \ 0.171\ (\text{wt.} = 8.54)\\
dc &= +0.144 & c &= +\ \ 0.394\ (\text{wt.} = 20.96)
\end{aligned}
$$

Ogden, September 26, 1878; before signals.

Name of star.	Clamp.	T.	B*b*.	A*a*.	C*c*.	T′.	A. R.	ΔT.
		h. m. s.	*s.*	*s.*	*s.*	*h. m. s.*	*h. m. s.*	*m. s.*
50 Draconis	E.	18 52 50.79	+0.16	−0.30	+0.94	18 52 51.59	18 50 16.61	−2 34.98
γ Lyræ	E.	18 56 59.80	+0.06	+0.02	+0.28	18 57 00.16	18 54 25.23	2 34.93
ζ Aquilæ	E.	19 02 25.83	+0.03	+0.06	+0.25	19 02 26.17	18 59 51.11	2 35.06
ι Lyræ	E.	05 33.89	+0.02	+0.02	+0.30	05 34.23	19 02 59.26	2 34.97
19 Lyræ	E.	09 42.43	+0.01	+0.03	+0.28	09 42.75	19 07 07.78	2 34.97
δ Draconis	E.	15 06.30	−0.02	−0.16	+0.63	15 06.75	19 12 31.83	2 34.92
φ Cygni	W.	37 11.45	−0.09	+0.03	−0.28	37 11.11	19 34 36.12	2 34.99
28 Heis Cygni	W.	40 40.79	−0.09	+0.03	−0.28	40 40.45	19 38 05.53	2 34.92
δ Sagittæ	W.	44 35.21	−0.07	+0.06	−0.25	44 34.95	19 42 00.04	2 34.91
12 Vulpeculæ	W.	48 27.12	−0.08	+0.05	−0.26	48 26.83	19 45 51.80	2 35.03
ε Draconis	W.	51 11.49	−0.19	−0.19	−0.70	51 10.41	19 48 35.37	2 35.04
γ Sagittæ	W.	19 55 58.21	−0.07	+0.05	−0.25	19 55 57.94	19 53 22.99	−2 34.95

NORMAL EQUATIONS.

$$a_0 = +0^s.15 \qquad c_0 = +0^s.25 \qquad \Delta T_0 = -2^m\ 34^s.98 \text{ for } 19^h.5$$

$$\begin{aligned} &\qquad\ \ s. \\ 0 &= -0.078 + 9.50\,d\Delta T + 0.92\,da - 0.02\,dc \\ 0 &= +0.014 + 0.92\,d\Delta T + 3.22\,da - 2.39\,dc \\ 0 &= +0.177 - 0.02\,d\Delta T - 2.39\,da + 20.36\,dc \end{aligned}$$

$$\begin{aligned} &\qquad\quad s. & &\qquad\quad m.\ \ s. \\ \Delta T &= +0.010 & \Delta T &= -2\ 34.97\ (\text{wt.} = 9.21) \\ da &= -0.015 & a &= +\ \ 0.135\ (\text{wt.} = 2.85) \\ dc &= -0.010 & c &= +\ \ 0.240\ (\text{wt.} = 18.54) \end{aligned}$$

Ogden, September 26, 1878; after signals.

Name of star.	Clamp.	T.			Bb.	Aa.	Ca.	T′.			A.R.			ΔT.	
		h.	m.	s.	s.	s.	s.	h.	m.	s.	h.	m.	s.	m.	s.
η Pegasi	W.	22	39	55.65	−0.02	+0.09	−0.25	22	39	55.47	22	37	20.94	−2	34.53
λ Pegasi	W.		43	18.06	−0.02	+0.14	−0.25		43	17.93	22	40	43.22	2	34.71
ι Cephei	W.	22	47	59.98	−0.04	−0.40	−0.53	22	47	59.01	22	45	24.33	2	34.68
β Pegasi	W.	23	00	30.41	−0.02	+0.11	−0.25	23	00	30.25	22	57	55.62	2	34.63
56 Pegasi	W.		03	49.19	−0.02	+0.12	−0.24		03	49.05	23	01	14.30	2	34.75
π Cephei	W.	23	06	42.34	−0.05	−0.84	−0.84	23	06	40.61	23	04	05.95	−2	34.66

NORMAL EQUATIONS.

$a_0 = +\,0^s.40 \qquad c = +\,0^s.22 \qquad \Delta T_0 = -\,2^m\,34^s.65 \text{ for } 22^h.8$

$$0 = +\overset{s.}{0.038} + 4.49\,d\Delta T + 0.12\,da$$
$$0 = \;\;.0.000 + 0.12\,d\Delta T + 1.86\,da$$

$$d\Delta T = -\,\overset{s.}{0.008} \qquad \Delta T = -\,\overset{m.}{2}\;\overset{s.}{34.658} \text{ (wt. = 4.49)}$$
$$da = +\,0.001 \qquad a = +\;\;0.401 \text{ (wt. = 1.86)}$$

The value of *c* was obtained from other nights' work and the previous observations of this night; it clouded up after reversal.

Ogden, September 27, 1878; before signals.

Name of star.	Clamp.	T.			B*b*.	A*a*.	C*c*.	T.′			A. R.			Δ T.	
		h.	*m.*	*s.*	*s.*	*s.*	*s.*	*h.*	*m.*	*s.*	*h.*	*m.*	*s.*	*m.*	*s.*
φ Cygni	E.	19	37	09.49	+ 0.02	+ 0.06	+ 0.25	19	37	9.82	19	34	36.11	−2	33.71
28 Heis Cygni	E.		40	38.87	+ 0.02	+ 0.05	+ 0.25		40	39.19	19	38	05.51	2	33.68
δ Sagittæ	E.		44	33.28	+ 0.02	+ 0.11	+ 0.23		44	33.64	19	42	00.02	2	33.62
12 Vulpeculæ	E.		48	25.13	+ 0.02	+ 0.09	+ 0 23		48	25.47	19	45	51.78	2	33.69
ε Draconis	E.		51	08.51	+ 0.05	− 0.37	+ 0.63		51	08.82	19	48	35.31	2	33.51
γ Sagittæ	E.	19	55	56.34	+ 0.02	+ 0.10	+ 0.23	19	55	56.69	19	53	22.98	2	33.71
κ Cephei	W.	20	15	33.08	− 0.01	− 0.71	− 0.98	20	15	31.38	20	12	57.68	2	33.70
γ Cygni	W.		20	27.60	− 0.01	+ 0.01	− 0.28		20	27.32	20	17	53.73	2	33.59
40 Cygni	W.		25	39.61	− 0.01	+ 0.02	− 0.27		25	39.35	20	23	05.89	2	33.46
ε Delphini	W.		30	00.27	0.00	+ 0.13	− 0.22		30	00.18	20	27	26.47	2	33.71
73 Draconis	W.		35	41.94	− 0.01	− 0.54	− 0.81		35	40.58	20	33	06.70	2	33.88
Pi. XX. 283	W.	20	40	12.48	0.00	+ 0.03	− 0.26	20	40	12.25	20	37	38.54	−2	33.71

NORMAL EQUATIONS.

$a_0 = +0^s.25 \qquad c_0 + 0^s.20 \qquad \Delta T_0 = -2^m 33^s.65$ for $20^h.0$

$$\begin{aligned}
& \quad\ \ s. \\
0 &= +0.168 + 9.19\, d\Delta T + 0.73\, da + 0.23\, dc \\
0 &= -0.074 + 0.73\, d\Delta T + 3.87\, da + 3.48\, dc \\
0 &= -0.354 + 0.23\, d\Delta T + 3.48\, da + 21.40\, dc
\end{aligned}$$

$$\begin{aligned}
& \qquad\ \ s. && \qquad\quad m. \quad s. \\
d\Delta T &= -0.019 & \Delta T &= -2 \quad 33.669 \text{ (wt. = 9.05)} \\
da &= +0.009 & a &= + \quad\ \ 0.259 \text{ (wt. = 3.49)} \\
dc &= +0.015 & c &= + \quad\ \ 0.215 \text{ (wt. =19.57)}
\end{aligned}$$

Ogden, September 27, 1878; after signals.

Name of star.	Clamp.	T.	B *b*.	A *a*.	Ç *c*.	T′.	A. R.	ΔT.
		h. m. s.	*s.*	*s.*	*s.*	*h. m. s.*	*h. m. s.*	*m. s.*
226 Cephei B	W.	22 32 45.94	+ 0.18	− 0.57	− 0.70	22 32 44.85	22 30 11.48	− 2 33.37
μ Pegasi	W.	46 44.37	+ 0.06	+ 0.08	− 0.19	46 44.32	22 44 10.81	2 33.51
B. A. C. 7984	W.	51 08.83	+ 0.07	+ 0.01	− 0.23	51 08.68	22 48 34.95	2 33.73
Pi. XXII. 261	W.	22 54 40.21	+ 0.07	− 0.17	+ 0.01	22 54 40.12	22	....
β Pegasi	W.	23 00 29.23	+ 0.06	+ 0.07	− 0.20	23 00 29.16	22 57 55.62	2 33.54
56 Pegasi	W.	03 47.74	+ 0.06	+ 0.08	− 0.19	03 47.69	23 01 14.30	2 33.39
π Cephei	E.	06 39.22	+ 0.14	− 0.53	+ 0.66	06 39.49	23 04 05.93	2 33.56
τ Pegasi	E.	17 13.24	+ 0.04	+ 0.09	+ 0.19	17 13.56	23 14 40.00	2 33.56
Pegasi	E.	21 54.76	+ 0.04	+ 0.09	+ 0.19	21 55.08	23 19 21.56	2 33.52
Pegasi	E.	25 36.54	+ 0.04	+ 0.13	+ 0.18	25 36.89	23 23 03.21	2 33.68
Pegasi	E.	23 30 31.31	+ 0.05	+ 0.05	+ 0.20	23 30 31.61	23 27 58.22	− 2 33.39

NORMAL EQUATIONS.

$a_0 = +0^s.25 \qquad c_0 = +0^s.20 \qquad \Delta T_0 = -2^m\,33^s.54 \text{ for } 23^h.0$

$$\begin{aligned}
&\quad\ \ s.\\
0 &= -0.037 + 8.01\, d\Delta T + 1.28\, da - 0.07\, dc\\
0 &= -0.001 + 1.28\, d\Delta T + 2.90\, da + 0.54\, dc\\
0 &= +0.436 - 0.07\, d\Delta T + 0.54\, da + 16.61\, dc
\end{aligned}$$

$$\begin{aligned}
&\quad\ \ s. & &\qquad m.\quad s.\\
d\Delta T &= +0.004 & \Delta T &= -2\ \ 33.596\ (\text{wt.} = 7.50)\\
da &= +0.003 & a &= +\quad 0.258\ (\text{wt.} = 2.78)\\
dc &= -0.026 & c &= +\quad 0.174\ (\text{wt.} = 16.50)
\end{aligned}$$

Ogden, September 30, 1878; before signals.

Name of star.	Clamp.	T.			B *b*.	A *a*.	C *c*.	T′.			A. R.			Δ T.	
		h.	*m.*	*s.*	*s.*	*s.*	*s.*	*h.*	*m.*	*s.*	*h.*	*m.*	*s.*	*m.*	*s.*
28 Heis Cygni	W.	19	40	34.07	+ 0.02	+ 0.07	− 0.29	19	40	33.87	19	38	05.45	− 2	28.42
δ Sagittæ	W.		44	28.39	+ 0.02	+ 0.15	− 0.26		44	28.30	19	41	59.96	2	28.34
12 Vulpeculæ	W.		48	20.15	+ 0.02	+ 0.13	− 0.26		48	20.04	19	45	51.73	2	28.31
15 Vulpeculæ	W.	19	58	35.81	+ 0.02	+ 0.10	− 0.28	19	58	35.65	19	56	07.36	2	28.29
η Sagittæ	W.	20	02	16.38	+ 0.02	+ 0.15	− 0.26	20	02	16.29	19	59	47.89	2	28.40
κ Cephei	W.		15	28.15	+ 0.08	− 1.01	− 1.11		15	26.11	20	12	57.39	2	28.72
ε Delphini	E.		29	54.54	− 0.04	+ 0.19	+ 0.25		29	54.94	20	27	26.43	2	28.51
73 Draconis	E.		35	35.06	− 0.15	− 0.78	+ 0.91		35	35.04	20	33	06.52	2	28.52
ε Cygni	E.		43	47.62	− 0.06	+ 0.06	+ 0.29		43	47.91	20	41	19.54	2	28.37
Pi. XX., 358	E.		48	48.55	− 0.05	+ 0.10	+ 0.27		48	48.87					
32 Vulpeculæ	E.		51	53.07	− 0.05	+ 0.10	+ 0.27		51	53.39	20	49	24.85	2	28.54
Br. 2749	E.	20	55	32.09	− 0.22	− 1.37	+ 1.41	20	55	31.91	20	53	04.00	− 2	27.91

NORMAL EQUATIONS.

$a_0 = +0^s.40 \quad c_0 = +0^s.25 \quad \Delta T_0 = -2^m\ 28^s.42$ for $20^h.0$

$$\begin{aligned} & \quad s. \\ 0 &= -0.120 + 8.16\,d\Delta T + 1.03\,da - 1.29\,dc \\ 0 &= +0.079 + 1.03\,d\Delta T + 4.79\,da - 2.90\,dc \\ 0 &= +0.099 - 1.29\,d\Delta T - 2.90\,da + 20.49\,dc \end{aligned}$$

$$\begin{array}{rlrl} & \quad s. & & m.\quad s. \\ d\Delta T = & +0.019 & \Delta T = & -2\ \ 28.401\ (\text{wt.} = 7.92) \\ da = & -0.024 & a = & +\ \ 0.376\ (\text{wt.} = 4.29) \\ dc = & -0.007 & c = & +\ \ 0.243\ (\text{wt.} = 18.66) \end{array}$$

Ogden, September 30, 1878; after signals.

Name of star.	Clamp.	T.	Bb.	Aa.	Cc.	T'.	A. R.	ΔT.
		h. m. s.	s.	s.	s.	h. m. s.	h. m. s.	m. s.
72 Pegasi	E.	23 30 25.93	+ 0.08	+ 0.00	+ 0.26	23 30 26.27	23 27 58.22	− 2 28.05
γ Cephei	E.	23 36 55.19	+ 0.08	− 1.11	+ 0.97	23 36 55.13	23 34 26.99	2 28.14
α Andromedæ	E.	0 04 36.87	+ 0.02	+ 0.11	+ 0.25	0 04 37.25	00 02 08.64	2 28.61
γ Pegasi	E.	0 09 25.31	+ 0.02	+ 0.20	+ 0.23	0 09 25.76	00 06 57.52	− 2 28.24

NORMAL EQUATIONS.

$a_0 = +0^s.37 \qquad c = +0^s.28 \qquad \Delta T_0 = -2^m\ 29^s.10 \text{ for } 0^h.0$

$$0 = -\overset{s.}{0.088} + 2.04\, d\Delta T + 0.41\, da$$
$$0 = -0.096 + 0.41\, d\Delta T + 1.56\, da$$

$$d\Delta T = +\overset{s.}{0.033} \qquad \Delta T = -\overset{m.}{2}\ \overset{s.}{29.067}$$
$$da = +0.050 \qquad a = +\ 0.420$$

The value of *c* was obtained by combining the value obtained before signals with the general mean for previous and following nights.

Ogden, October 1, 1878; before signals.

Name of star.	Clamp.	T.			Bb.	Aa.	Cc.	T′.			A. R.				
		h.	*m.*	*s.*	*s.*	*s.*	*s.*	*h.*	*m.*	*s.*	*h.*	*m.*	*s.*	*m.*	*s.*
9 Cygni	E.	19	32	28.85	+ 0.06	+ 0.10	+ 0.25	19	32	29.26	19	30	02.59	− 2	26.67
φ Cygni	E.		37	02.30	+ 0.05	+ 0.09	+ 0.25		37	02.69	19	34	36.03	2	26.66
28 Heis Cygni	E.		40	31.76	+ 0.05	+ 0.08	+ 0.26		40	32.15	19	38	05.43	2	26.72
δ Sagittæ	E.		44	26.18	+ 0.03	+ 0.17	+ 0.23		44	26.61	19	41	59.95	2	26.66
ε Draconis	E.	19	51	01.52	+ 0.03	− 0.59	+ 0.64	19	51	01.60	19	48	35.06	2	26.54
ρ Aquilæ	W.	20	11	07.84	− 0.04	+ 0.19	− 0.23	20	11	07.76	20	08	41.09	2	26.67
κ Cephei	W.		15	26.33	− 0.17	− 1.13	− 1.00		15	24.03	20	12	57.29	2	26.74
39 Cygni	W.		21	28.90	− 0.05	+ 0.08	− 0.26		21	28.76	20	19	02.17	2	26.59
41 Cygni	W.		26	54.27	− 0.05	+ 0.09	− 0.25		26	54.06	20	24	27.60	2	26.46
ε Delphini	W.		29	53.19	− 0.04	+ 0.22	− 0.22		29	53.15	20	27	26.41	2	26.74
73 Draconis	W.	20	35	34.95	− 0.14	− 0.86	− 0.82	20	35	33.13	20	33	06.40	− 2	26.73

NORMAL EQUATIONS.

$$a_0 = +0^s.50 \qquad c_0 = +0^s.20 \qquad \Delta T_0 = -2^m\ 26^s.65 \text{ for } 20^h.0$$

$$0 = +0.065 + 8.38\, d\Delta T + 0.85\, da - 0.61\, dc$$
$$0 = +0.277 + 0.85\, d\Delta T + 3.92\, da + 2.30\, dc$$
$$0 = -0.171 - 0.61\, d\Delta T + 2.30\, da + 19.76\, dc$$

$$d\Delta T = +\overset{s}{0}.002 \qquad \Delta T = -\overset{m}{2}\ \overset{s}{26}.648 \text{ (wt. = 8.13)}$$
$$da = -0.081 \qquad a = +\ 0.419 \text{ (wt. = 3.55)}$$
$$dc = +0.018 \qquad c = +\ 0.218 \text{ (wt. = 18.26)}$$

Ogden, October 1, 1878; after signals.

Name of star.	Clamp.	T.			B*b*.	A*a*.	C*c*.	T'.			A. R.			ΔT.	
		h.	*m.*	*s.*	*s.*	*s.*	*s.*	*h.*	*m.*	*s.*	*h.*	*m.*	*s.*	*m.*	*s.*
τ Pegasi	W.	23	17	06.24	0.00	+ 0.19	− 0.14	23	17	06.29	23	14	40.03	− 2	26.26
υ Pegasi	W.		21	47.88	0.00	+ 0.20	− 0.14		21	47.94	23	19	21.56	2	26.38
72 Pegasi	W.		30	24.60	0.00	+ 0.12	− 0.15		30	24.57	23	27	58.22	2	26.35
153 Heis Pegasi	W.		32	58.12	0.00										
γ Cephei	W.		36	55.46	0.00	− 1.48	− 0.55		36	53.43	23	34	26.98	2	26.45
41 H. Cephei	E.		44	36.71	− 0.02	− 0.64	+ 0.32		44	36.37	23	42	10.06	2	26.31
ψ Pegasi	E.		54	02.82	− 0.01	+ 0.18	+ 0.14		54	03.13	23	51	36.85	2	26.28
85 Pegasi	E.	23	58	18.32	− 0.01	+ 0.16	+ 0.14	23	58	18.61	23	55	52.29	2	26.32
α Andromedæ	E.	0	04	35.36	− 0.01	+ 0.14	+ 0.14	0	04	35.63	0	02	09.25	2	26.38
γ Pegasi	E.	0	09	27.63	− 0.01	+ 0.27	+ 0.13	0	09	28.02	0	07	01.52	− 2	26.50

NORMAL-EQUATIONS.

$a_0 = +0^s.50 \qquad c_0 = +0^s.20 \qquad \Delta T_0 = -2^m.\ 26^s.35 \text{ for } 23^h.7$

$$
\begin{aligned}
0 &= +\overset{s.}{0.057} + 7.29\, d\Delta T + 1.15\, da + 1.31\, dc \\
0 &= -0.078 + 1.15\, d\Delta T + 2.52\, da + 1.33\, dc \\
0 &= +1.011 + 1.31\, d\Delta T + 1.23\, da + 14.68\, dc
\end{aligned}
$$

$$
\begin{aligned}
d\Delta T &= -\overset{s.}{0.006} & \Delta T &= -\overset{m.}{2}\ \ \overset{s.}{26.356}\ (\text{wt.} = 6.73) \\
da &= +0.073 & a &= +\ \ 0.573\ (\text{wt.} = 2.25) \\
c &= -0.075 & c &= +\ \ 0.125\ (\text{wt.} = 12.91)
\end{aligned}
$$

Name of star.	Clamp.	T.			Bb.	Aa.	Cc.	T′.			A. R.			ΔT.	
		h.	m.	s.	s.	s.	s.	h.	m.	s.	h.	m.	s.	m.	s.
9 Cygni	W.	19	32	25.20	- 0.02	+ 0.07	- 0.19	19	32	25.06	19	30	02.55	— 2	22.51
φ Cygni	W.		36	58.60	0.05	+ 0.07	- 0.19		36	58.43	19	34	35.90	2	22.44
28 Heis Cygni	W.		40	28.00	— 0.06	+ 0.06	— 0.20		40	27.89	19	38	05.38	2	22.51
δ Sagittæ	W.		44	22.40	— 0.05	+ 0.13	- 0.18		44	22.30	19	41	59.91	2	22.39
ε Draconis	W.	19	50	58.50	- 0.18	- 0.44	— 0.49	19	50	57.39	19	48	34.93	2	22.46
ρ Aquilæ	E.	20	11	03.27	- 0.06	+ 0.14	+ 0.17	20	11	03.52	20	08	41.05	2	22.47
κ Cephei	E.		15	19.79	- 0.22	- 0.84	+ 0.77		15	19.50	20	12	57.09	2	22.41
39 Cygni	E.		21	24.34	— 0.07	+ 0.06	+ 0.20		21	24.53	20	19	02.13	2	22.40
41 Cygni	E.		26	49.81	- 0.08	+ 0.07	+ 0.19		26	49.99	20	24	27.57	2	22.42
ε Delphini	E.		29	48.65	- 0.06	+ 0.16	+ 0.17		29	48.92	20	27	26.38	2	22.54
73 Draconis	E.	20	35	20.02	- 0.25	- 0.65	+ 0.63	20	35	28.75	20	33	06.25	— 2	22.50

NORMAL EQUATIONS.

$a_0 = +0^s.40 \qquad c_0 = +0^s.20 \qquad \Delta T_0 = -2^m.22^s.46$ for $20^h.0$

$$\begin{array}{l} {}^{s.} \\ 0 = +0.009 + 8.38\, d\Delta T + 0.85\, da + 0.61\, dc \\ 0 = +0.273 + 0.85\, d\Delta T + 3.94\, da - 2.20\, dc \\ 0 = +0.430 + 0.61\, d\Delta T - 2.20\, da + 19.75\, dc \end{array}$$

$$\begin{array}{llll} & s. & m. & s. \\ d\Delta T = -0.001 & \Delta T = - & 2 & 22.461\ (\text{wt.} = 8.13) \\ da = -0.087 & a = + & & 0.313\ (\text{wt.} = 3.59) \\ dc = -0.032 & c = + & & 0.168\ (\text{wt.} = 18.38) \end{array}$$

Ogden, October 3, 1878; after signals.

Name of star.	Clamp.	T.	B*b*.	A*a*.	C*c*.	T′.	A. R.	ΔT.
		h. m. s.	*s.*	*s.*	*s.*	*h. m. s.*	*h. m. s.*	*m. s.*
ι Cephei	E.	22 47 46.62	+ 0.15	− 0.45	+ 0.45	22 47 46.77	22 45 24.21	− 2 22.56
β Pegasi	E.	23 00 17.42	+ 0.03	+ 0.12	+ 0.21	23 00 17.78	22 57 55.60	2 22.18
56 Pegasi	E.	03 36.14	+ 0.02	+ 0.14	+ 0.20	03 36.50	23 01 14.28	2 22.22
Pi. XXIII. 4	E.	07 05.10	0.00	+ 0.19	+ 0.19	07 05.48	23 04 43.08	2 22.40
o Cephei	E.	16 03.82	− 0.06	− 0.52	+ 0.48	16 03.72	23 13 41.66	2 22.06
72 Pegasi	W.	30 20.60	− 0.06	+ 0.10	− 0.22	30 20.42	23 27 58.21	2 22.21
γ Cephei	W.	36 51.38	− 0.14	− 1.17	− 0.82	36 49.25	23 34 26.94	2 22.31
78 Pegasi	W.	40 18.10	− 0.04	+ 0.11	− 0.21	40 17.96	23 37 55.57	2 22.39
79 Pegasi	W.	45 55.61	− 0.04	+ 0.12	− 0.21	45 55.48	23 43 33.26	2 22.22
φ Pegasi	W.	23 48 43.53	− 0.03	+ 0.18	− 0.20	23 48 43.48	23 46 21.15	2 22.33

NORMAL EQUATIONS.

$a_0 = +0^s.40 \qquad c_0 = +0^s.20 \qquad \Delta T_0 = -2^m\ 22^s.27 \text{ for } 23^h.5$

$$\begin{aligned} 0 &= +0.104^s + 7.74\ d\Delta T + 0.59\ da + 0.31\ dc \\ 0 &= -0.154 + 0.59\ d\Delta T + 2.96\ da - 0.38\ dc \\ 0 &= +0.265 + 0.31\ d\Delta T - 0.38\ da + 17.55\ dc \end{aligned}$$

$$\begin{aligned} d\Delta T &= -0.017^s & \Delta T &= -2^m\ 22^s.287 \text{ (wt. = 7.61)} \\ da &= +0.053 & a &= +\ 0.453 \text{ (wt. = 2.91)} \\ dc &= -0.014 & c &= +\ 0.186 \text{ (wt. = 17.50)} \end{aligned}$$

FORM No. 12.

Signals sent from—	Recorded at—	Mean of signals sent and received.	Time corrections.	Corrected time.	Difference of longitude.	Double wave time.	Means.
		h. m. s.	h. m. s.	h. m. s.	m. s.		m. s.
September 26:							
Ogden	Fort Bayard	22 14 30.00	— 2 34.75	22 11 55.25		0.70	15 23.050
		12 11 3.36	+10 16 15.29	22 27 18.65	15 23.40		
Fort Bayard........	Ogden	22 22 18.63	— 2 34.74	22 19 43.89			
		12 18 50.00	+10 16 16.59	22 35 06.59	15 22.70		
September 27:							
Ogden	Fort Bayard	22 7 30.00	— 2 33.56	22 4 56.44		0.40	15 22.930
		12 0 4.32	+10 20 15.25	22 20 19.57	15 23.13		
Fort Bayard........	Ogden	22 14 7.04	— 2 33.56	22 11 33.48			
		12 6 40.00	+10 20 16.21	22 26 56.21	15 22.73		
September 30:							
Ogden	Fort Bayard	22 31 30.00	— 2 28.21	22 29 1.79		0.51	15 23.165
		12 12 2.17	+10 32 23.04	22 44 25.21	15 23.42		
Fort Bayard........	Ogden	22 54 22.15	— 2 28.18	22 51 53.97			
		12 34 50.00	+10 32 26.88	23 7 16.88	15 22 91		
October 1:							
Ogden	Fort Bayard	22 56 35.00	— 2 26.42	22 54 8.58		0.52	15 23.050
		12 33 3.39	+10 36 28.50	23 9 31.89	15 23.31		
Fort Bayard........	Ogden	23 2 43.16	— 2 26.42	23 0 16.74			
		12 39 10.00	+10 36 29.53	23 15 39.53	15 22.79		
October 3:							
Ogden	Fort Bayard	22 21 30.00	— 2 22.32	22 19 7.68		0.71	15 23.095
		11 50 6.18	+10 44 24.95	22 34 31.13	15 23.45		
Fort Bayard........	Ogden	22 31 26.16	— 2 22.30	22 29 3.86			
		12 0 0.00	+10 44 26.60	22 44 26.60	15 22.74		

Final difference of longitude: 15ᵐ. 23ˢ.058 ± 0ˢ.025, or 3° 50′ 45″.87 ± 0″.38.

Subtracting this value from the longitude of Ogden as given in the quarto report, we find 108° 9′ 8″.77 for the longitude of Fort Bayard.

For the personal equation, see report on geographical position of Fort Bliss.

Mean place of stars for 1878.0 *used for the determination of latitude of Fort Bayard, N.*

No. B. A. C.	Class.	R. A.	Declination.
		h. m. s.	° ′ ″
6626	A	19 15 22	49 20 37.6
6642	B	19 18 53	16 42 5.2
6647	B	19 19 16	16 43 10.7
1)	C	19 21 57	14 2 14.1
2)	C	19 23 45	14 20 47.2
6697	A	19 26 38	51 28 13.4
6723	A	19 31 10	50 58 31.4
6748	B	19 35 57	54 41 15.8
6772	AA	19 40 28	10 19 1.9
6783	B	19 41 57	12) 18 14 4.0
6799	C	19 43 53	47 36 24.6
6833	AA	19 49 19	13) 6 6 11.6
6852	B	19 51 24	59 23 10.4
6867	C	19 53 36	58 31 14.8
6893	A	19 58 11	14) 6 56 5.2
6926	A	20 2 16	67 31 32.5
6934	A	20 5 1	15) — 1 10 55.9
6966	A	20 10 6	25 13 13.8
6986	B	20 12 35	39 59 18.0
6996	B	20 13 48	40 21 8.5
7022	A	20 17 51	39 52 1.3
3)	C	20 26 45	25 23 39.2
7146	A	20 33 25	15 24 38.8
7149	AA	20 33 58	15 28 57.9
7182	A	20 38 27	49 54 8.6
7200	A	20 41 0	15 41 8.6
7220	A	20 42 48	61 21 54.8
7255	A	20 49 34	16) 4 4 4.1
7275	A	20 52 49	21 51 18.1
7290	A	20 53 57	43 59 48.0
7333	A	21 0 30	43 26 30.3
7356	A	21 5 2	21 57 30.8
4)	C	21 11 47	17) 43 43 44.3
7402	A	21 13 54	43 25 59.1
7418	AA	21 16 27	19 17 0.0
5)	C	21 16 55	17) 46 12 37.9
7455	A	21 20 51	46 11 10.6
6)	C	21 23 26	46 1 49.8
7480	A	21 24 57	46 0 11.2
7)	C	21 25 7	45 53 31.2
7544	A	21 35 24	42 43 13.6
7585	A	21 40 28	22 23 13.7
7598	A	21 42 17	48 44 43.8
7606	A	21 44 20	16 43 8.6
7681	C	21 58 1	44 3
7705	B	22 1 6	44 2
7712	A	22 2 7	21
7723	A	22 4 3	5 3
7759	B	22 8 0	60
7777	A	22 10 39	37
7798	A	22 15 41	27 4
7814	A	22 19 3	14) 0 4
7837	B	22 23 10	64 3
8)	B	22 34 03	18) 36 5
7914	A	22 36 2	28 4
7932	A	22 38 39	41 1
7958	A	22 44 7	23 5
8023	A	22 56 19	41 4
8071	A	23 3 53	9
8083	A	23 7 25	56 2
8131	A	23 14 36	23
8160	A	23 19 17	22 4
8229	A	23 32 9	42 3
8243	A	23 35 49	19) 1
9)	C	23 36 36	17) 63 5
8300	A	23 46 24	10 1
8322	C	23 51 0	55
8330	B	23 52 50	55
8	B	0 2 45	17 3
10)	C	0 5 36	47 2
58	A	0 11 57	36
109	A	0 23 41	29
142	B	0 28 36	12 4
153	A	0 30 11	53 1
173	A	0 34 31	38 4
229	A	0 43 20	27
201	B	0 38 21	54 3
11)	C	0 39 7	20) 54 3
213	B	0 40 40	11 1
222	A	0 42 21	15) 6 5
244	C	0 47 46	58 1
254	B	0 49 25	58 3
288	A	0 56 37	13) 7 1
334	AA	1 2 54	34 5
345	B	1 4 23	30 4

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1) Sd. 939.
2) Sd 946.
3) 43* Heis Vulpeculæ.
4) Groom. 3420.
5) Groom. 3438.
6) Sd. 1318.
7) Sd. 1323.
8) 28 Heis Lacertæ.
9) Groom. 4130 = Dm. 63° 2038 C. S.
10) Groom. 9 = Sd. 1735.
11) Groom. 137 = Pi. 0.168.
12) This star's declination has been corrected by —0.″8 by the German Society's new catalogu pending upon newer observations; it will no classed A.
13) Declination from mean of G. and B.
14) Declination from B.
15) Declination from G.
16) Declination only approximate.
17) Declination only approximate from R. C
18) Declination from Main 71—2—3; thr servations which do not agree well.
19) From American Ephemeris for 1881, p. 3
20) Position from a preliminary discussion.

Observations and computations for latitude, Fort Bayard, N. Mex.

Date.	Number of star.	Micrometer readings.	Level.		Half sum of declination.	Corrections.			Latitude.
			N.	S.		Micr. and refr.	Level.	Merid.	
					° ′ ″	′ ″	″		° ′ ″
ber 4, 1878	....	23.989	15.0	35.0	32 47 22.1	+ 0 19.4	− 0.4	....	32 47 41.1
	6687	37.702	37.0	13.2					
	6723	9.025	32.0	18.4					
	a6748	9.581	28.6	22.0	32 30 26.8	+17 12.5	− 2.9	....	36.4
	a6772	43.823	17.0	33.0					
	6783	16.803	28.6	22.0	32 55 33.4	− 7 49.4	− 2.9	....	41.1
	6799	31.917	17.0	32.8					
	6833	21.475	25.6	25.4	32 44 59.2	+ 2 42.8	+ 0.4	....	42.4
	6852	26.715	26.0	25.0					
	6867	28.025	30.0	21.0	32 43 59.0	+ 3 45.3	− 2.9	....	41.4
	6893	20.772	15.8	34.2					
	6966	39.055	27.8	22.8	32 34 48.4	+12 53.6	+ 1.7	....	43.7
	6986	17.653	26.0	24.8					
	7022	10.642	25.2	25.4					
	7149	29.725	15.2	35.4	32 44 58.8	+ 2 44.6	− 0.5	....	42.9
	7182	18.446	32.4	18.6					
	b7200	17.762	30.8	20.6					
	7220	28.880	16.6	35.0	32 43 22.1	+ 4 19.9	− 0.6	....	41.4
	7255	20.513	34.0	17.6					
	7275	24.556	31.2	20.6	32 46 19.9	+ 1 20.9	− 2.5	....	38.3
	7290	8.558	17.0	35.0					
	7333	40.687	15.6	37.0					
	c7356	30.510	31.8	20.6					
	7402	41.172	17.2	35.0					
	7418	33.453	15.6	36.6	32 41 46.2	+ 5 54.7	+ 0.7	....	41.6
	7455	27.352	38.0	14.4					
	7480	16.717	37.6	14.8					
	7544	11.517	13.2	38.0	32 33 40.4	+13 58.7	− 0.1	....	39.0
	7585	38.519	38.6	14.0					
	7598	27.046	35.8	16.0	32 44 22.9	+ 3 16.7	+ 4.1	....	43.7
	7606	20.714	23.0	29.6					
	7723	29.457	23.2	30.0	32 53 4.4	− 5 25.2	+ 4.9	....	44.1
	7759	18.984	37.8	15.2					
	7814	34.945	22.6	31.4	32 38 31.2	+ 9 8.0	+ 1.3	....	40.5
	7837	17.302	33.4	20.4					
	....	26.762	38.6	15.4	32 49 21.2	− 1 41.3	+ 4.0	....	43.9
	7914	23.501	21.8	32.2					
	7958	19.923	34.2	18.8	32 49 19.9	− 1 37.7	− 1.8	....	40.4
	8023	16.777	16.0	37.2					
	8071	23.637	24.4	28.6	32 50 9.0	− 2 26.4	− 0.7	....	41.9
	8083	28.349	27.4	25.6					
	8131	34.054	37.8	15.6	32 45 20.9	+ 2 19.7	− 0.3	....	40.3
	8160	14.364	38.4	15.8					
	8229	28.708	15.6	39.0					
	d8243	43.024	15.6	38.4	39 28 53.7	+18 44.9	0.0	....	38.6
	....	6.808	16.0	38.0					
	8300	18.948	34.0	21.0	32 40 4.9	+ 7 35.7	+ 4.7	....	45.3
	8322	35.000	29.6	25.4					
	8330	32.238	27.4	27.4					
	8	42.892	31.8	24.2	32 30 40.6	+16 58.3	− 1.4	....	32 47 37.5
	....	10.108	22.0	34.0					

[a] Difference should be 33r.242.

[b] I have assumed the level reading for 7200 = 20.6 N. 30.8 S.

[c] Possibly the middle point between 7354 and 7356 is taken; in this case add .3 to result.

[d] I suppose one level was misread; I don't know which.

Observations and computations for latitude, Fort Bayard, N. Mex.—Continued.

Date.	Number of star.	Micrometer readings.	Level.		Half sum of declination.	Corrections.			Latit
			N.	S.		Micr. and refr.	Level.	Merid.	
					° ′ ″	′ ″	″		° ′
October 4, 1878	58	14.129	33.2	23.6	32 36 6.1	+11 33.7	− 1.6	....	32 47
	109	36.464	20.8	35.6					
	142	16.822	16.0	40.2	32 58 14.2	−10 30.2	− 0.1	....	
	153	37.112	40.0	16.2					
October 6, 1878	6748	9.965	27.0	24.0	32 30 26.9	+17 10.6	− 1.1	....	
	6772	43.146	22.6	29.0					
	6833	28.762	20.0	31.6	32 44 59.3	+ 2 41.2	− 0.7	....	
	6852	23.571	30.6	21.2					
	6867	20.945	23.2	28.8	32 43 59.2	+ 3 41.8	− 1.4	....	
	6893	28.086	26.4	25.4					
	6966	11.648	24.6	36.8	32 41 40.1	+ 6 1.4	− 0.9	....	
	6986	33.055	31.2	21.0					
	6996	11.929	31.2	20.8					
	7022	40.018	33.0	19.0					
	....	21.749	18.8	34.8					
	7146	15.690	......	......	32 43 14.9	+ 4 26.0	− 1.5	....	
	7149	19.847	25.0	29.0					
	7182	30.930	26.8	27.6					
	7200	31.560	25.0	29.0					
	7220	20.440	41.2	13.6	32 43 22.3	+ 4 21.1	+ 2.8	....	
	7255	28.847	17.8	36.4					
	7275	25.605	17.6	37.4	32 46 20.1	+ 1 22.1	+ 0.4	....	
	7290	41.551	38.4	16.6					
	7333	9.429	44.0	11.0					
	7356	19.624	11.4	44.2					
	7402	8.931	39.6	11.6					
	7418	17.538	42.2	14.0	32 41 7.9	+ 6 33.0	− 4.7	....	
	7455	23.624	9.4	46.4					
	....	32.659							
	7480	34.288	3.0	52+					
	7544	38.439	32.2	24.6	32 33 40.7	+13 59.9	− 0.4	....	
	7585	11.398	24.0	32.8					
	7598	22.904	33.0	24.0	32 44 23.1	+ 3 17.2	− 6.9	....	
	7606	29.252	12.6	44.4					
	7681	37.541	33.6	24.0	32 41 1.1	+ 6 40.8	+ 0.7	....	
	7705	16.734	33.2	24.4					
	7712	14.234	25.4	32.4					
	7723	30.133	37.6	20.4	32 53 4.7	− 5 21.8	− 0.1	....	
	7759	19.772	20.0	37.6					
	7777	46.605	22.2	35.6	32 26 13.3	+21 25.6	+ 2.2	....	
	779	5.214	39.2	18.6					
	....	27.653	39.4	18.6	32 49 21.6	− 1 40.0	− 5.4	....	
	7914	24.434	9.8	48.0					
	7932	41.362	19.2	39.4	32 41 58.1	+ 5 40.9	− 0.4	....	
	7958	16.193	42.4	16.6					
	8023	12.978	12.6	46.4					
	8071	23.579	27.4	32.0	32 50 9.3	− 2 27.8	− 0.7	....	
	8083	28.337	31.0	28.6					
	8131	33.769	30.0	20.4	32 45 21.3	+ 2 19.6	− 4.4	....	
	8160	13.967	34.0	25.4					
	8229	28.364	16.0	43.8					
	8	43.477	18.4	41.4	32 30 41.0	+16 58.6	− 3.8	....	
	....	10.684	35.6	25.0					
	58	14.255	38.6	21.4	32 36 6.5	+11 33.4	− 6.4	....	32
	109	36.580	11.0	49.0					

a Level of 6966 in error; I have used a mean level for this group.

***Observations and computations for latitude, Fort Bayard, N. Mex.*—Continued.**

Date.	Number of star.	Micrometer readings.	Level.		Half sum of declination.	Corrections.			Latitude.
			N.	S.		Micr. and refr.	Level.	Merid.	
					° ′ ″	′ ″	″		° ′ ″
tober 6, 1878.....	142	17.186	25.6	34.0	32 58 14.6	−10 30.9	+ 1.5	....	32 47 45.2
	153	37.500	37.0	23.6					
	173	33.765	29.2	30.4	32 55 30.5	− 7 49.6	+ 1.1	....	42.0
	229	18.646	32.2	27.6					
tober 7, 1878.....	6966	39.872	27.2	27.4	32 41 40.1	+ 6 2.0	− 1.8	....	40.3
	6986	18.553	26.8	28.0					
	6996	39.634	25.8	29.0					
	7022	11.544	24.4	30.0					
	....	29.923	25.0	29.8					
	7146	34.517	19.6	35.4	32 43 15.0	+ 4 27.2	− 2.9	....	39.3
	7149	30.346	19.2	35.8					
	7182	19.234	32.0	23.0					
	7200	18.648	16.0	39.0					
	7220	28.401	21.2	34.2	32 43 22.4	+ 4 8.6	− 2.5	....	28.5
	7255	20.403	30.8	26.0					
	7275	24.975	38.2	22.4	32 47 7.6	+ 0 33.3	− 1.8	....	39.1
	7290	8.938	22.4	33.6					
	7333	41.111	17.0	38.8					
	7356	30.955	35.0	20.8					
	....	24.480	19.8	36.6					
	7402	41.621	16.4	39.8					
	7418	33.029	28.6	27.8	32 40 52.1	+ 6 49.4	− 1.4	....	40.1
	....	28.316	26.0	30.4					
	7455	26.907	26.2	30.4					
	....	17.881	24.0	32.4					
	7480	16.258	26.0	30.4					
	....	9.875							
	7544	11.666	38.2	18.8	32 33 40.8	+14 1.9	− 5.7	....	37.0
	7585	38.772	9.4	47.2					
	7598	27.430	26.0	30.8	32 44 23.3	+ 3 16.2	+ 1.2	....	40.7
	7606	21.112	32.6	24.0					
	7681	12.750	37.4	19.4	32 41 1.2	+ 6 41.7	− 3.4	....	39.5
	7705	33.601	36.0	21.0					
	7712	36.142	14.6	42.0					
	7723	19.899	26.0	30.4	32 53 4.8	− 5 24.0	+ 0.4	....	41.2
	7759	30.330	31.2	25.4					
	7777	3.949	31.0	26.0	32 26 13.4	+21 29.9	− 4.8	....	38.5
	7798	45.477	17.8	38.4					
	7814	35.212	24.8	32.0	32 38 31.6	+ 9 11.3	+ 0.4	....	43.3
	7837	17.465	32.6	24.0					
	....	26.316	30.0	27.0	32 49 21.7	− 1 38.0	− 6.6	....	37.1
	7914	23.160	16.6	41.0					
	7932	40.449	29.0	26.2	32 41 58.3	+ 5 45.9	− 1.9	....	42.3
	7958	15.118	23.6	33.8					
	8023	12.058	31.8	26.2					
	8131	33.315	32.8	26.4	32 45 21.4	+ 2 20.8	− 6.9	....	35.3
	8160	13.493	26.8	32.4					
	8229	27.938	18.4	41.2					
	8243	43.883	15.0	43.8	32 28 54.2	+18 45.9	− 4.1	....	36.0
	....	7.635	37.4	21.8					
	8300	18.661	30.8	28.4	32 40 5.5	+ 7 36.5	− 2.5	....	39.5
	8322	34.753	26.0	33.2					
	8330	31.966	22.8	36.6					
	8	42.603	28.4	31.6	32 30 41.2	+16 58.4	− 1.5	....	38.1
	....	9.816	29.0	30.6					
	58	13.772	24.6	35.4	32 30 6.7	+11 35.4	+ 0.1	....	32 47 42.2
	109	36.162	35.6	24.4					

Observations and computations for latitude, Fort Bayard, N. Mex.—Continued.

Date.	Number of star.	Micrometer readings.	Level.		Half sum of declination.	Corrections.			Latitude.
			N.	S.		Micr. and refr.	Level.	Merid.	
					° ′ ″	′ ″	″		° ′ ″
October 7, 1878......	142	15.314	22.4	37.2	32 58 14.8	—10 31.2	— 1.7	....	32 47 41.9
	153	35.637	34.6	25.4					
	173	33.690	34.2	25.2	32 55 30.7	— 7 48.0	— 4.7	....	38.0
	229	18.621	17.4	41.6					
October 8, 1878......	6626	10.562	22.0	32.6	33 1 38.3	—13 57.4	+ 2.5	....	43.4
	6642	37.524	36.8	18.2					
	....	a8.232	30.4	25.0	32 42 43.9	+ 4 53.2	— 3.8	....	35.3
	....	27.116	27.6	27.8					
	6687	13.337	21.8	34.0					
	6723	42.020	19.2	36.6					
	6748	41.006	32.0	24.4	32 30 26.9	+17 12.4	— 3.6	....	35.7
	6772	7.767	18.8	38.0					
	6833	27.852	20.0	37.0	32 44 59.5	+ 2 41.8	— 1.3	....	40.0
	6852	22.643	35.0	22.2					
	6867	22.270	31.0	26.0	32 43 50.3	+ 3 43.8	— 3.5	....	39.6
	6893	29.477	20.6	36.8					
	6926	2.932	24.2	33.2	33 10 37.0	—22 55.2	— 1.8	....	40.0
	6984	47.207	(b)	(b)					
	6966	10.532	30.0	27.4	32 41 40.2	+ 6 0.9	+ 1.0	....	42.1
	6986	31.924	29.4	28.2					
	6996	10,715	34.0	23.6					
	7022	38.933	29.8	27.4					
	....	20.611	26.0	31.8					
	7146	15.384	31.2	26.8	32 43 15.1	+ 4 25.3	— 1.8	....	38.6
	7149	19.547	30.6	27.2					
	7182	30.636	22.6	35.2					
	7200	31.349	35.0	22.8					
	7220	21.462	37.0	20.6	32 43 22.5	+ 4 20.1	— 3.5	....	39.1
	7255	29.837	15.4	43.0					
	7275	25.993	32.8	26.0	32 46 20.4	+ 1 21.1	— 1.9	....	39.6
	7290	41.986	26.0	33.0					
	7333	9.776	23.0	36.2					
	7356	19.929	32.4	27.2					
	7402	9.283	21.8	38.0					
	7418	17.396	27.2	32.6	32 40 52.3	+ 6 53.0	— 5.3	....	40.0
	....	22.130	26.8	32.8					
	7455	23.564	23.4	36.2					
	....	32.538	25.4	34.2					
	7480	c33.125	.....	......					
	....	40.505	20.2	39.0					
	7544	38.903	24.4	35.0	32 33 41.0	+14 1.1	— 1.5	....	40.6
	7585	11.822	32.6	27.0					
	7598	22.991	45.0	14.8	32 44 23.4	+ 3 17.5	— 0.8	....	40.1
	7606	29.350	13.6	46.4					
	7681	37.792	27.8	32.6	32 41 1.4	+ 6 40.0	+ 0.2	....	41.6
	7705	16.967	28.0	32.4					
	7712	14.500	33.0	27.6					
	7723	29.759	32.6	27.8	32 53 5.0	— 5 23.7	— 1.9	....	39.4
	7759	19.338	24.8	35.8					
	7777	45,682	25.0	35.8	32 26 13.6	+21 25.3	+ 0.8	....	39.7
	7798	4.300	37.2	23.8					
	7814	d15.364	39.0	22.4	32 38 31.8	+ 9 8.9	+ 0.1	....	47 40.8
	7837	32.036	22.8	39.0					
	....	24.514	20.0	41.2	32 49 21.9	— 1 18.8	— 0.1	....	32 48 3.0
	e7914	27.050	41.2	20.4					

a 9r.232 used. b Missed. c Read 34r.125. d Micr. diff. 17r.672, not 16r. e Some mistake; I cannot tell what.

Observations and computations for latitude, Fort Bayard, N. Mex.—Continued.

Date.	Number of star.	Micrometer readings.	Level.		Half sum of declination.	Corrections.			Latitude.
			N.	S.		Micr. and refr.	Level.	Merid.	
					° ′ ″	′ ″	″		° ′ ″
ctober 8, 1878	7932	9.112	42.0	19.2	32 41 58.4	+ 5 43.7	+ 1.2	....	32 47 43.3
	7958	34.380	24.8	36.6					
	8023	37.514	35.0	26.6					
	*a*8071	27.789	40.4	21.6	32 50 9.6	− 2 28.0	− 1.4	....	40.2
	8083	22.025	19.2	42.4					
	8131	16.916	22.8	38.8	32 45 21.6	+ 2 20.6	− 3.0	....	39.2
	8160	36.554	24.4	37.2					
	8229	22.207	33.0	28.2					
	8243	6.594	23.0	38.0	32 28 54.4	+18 47.8	− 4.3	....	37.9
	....	42.903	26.0	25.0					
	8300	31.228	24.0	37.0	32 40 5.6	+ 7 36.0	− 1.4	....	40.2
	8322	15.129	34.0	27.0					
	8330	17.966	35.6	25.6					
	8	6.900	37.0	24.6	32 30 41.4	+16 58.9	− 3.7	....	36.6
	....	39.703	18.6	42.8					
	*b*58	36.993	26.2	35.0	32 36 6.9	+11 34.5	− 0.6	....	40.8
	100	13.634	34.0	27.2					
	*c*142	38.854	35.2	26.4	32 58 15.0	−10 35.0	+ 3.2	....	43.2
	153	13.409	31.4	30.0					
	201	16.142	31.0	30.2	32 57 35.0	− 9 52.4	+ 1.6	....	44.2
	....	11.227	31.0	30.4					
	213	32.758	33.0	28.4					
	222	15.483	27.0	34.4	32 45 15.7	+ 2 25.9	− 4.2	....	37.4
	244	35.285	22.0	39.2					
	254	23.183	22.6	38.6					
	288	*d*13.588	37.8	24.4					
	334	26.041	31.0	31.4	32 52 56.0	− 5 14.2	− 0.7	....	41.1
	345	15.924	30.2	32.0					
ctober 9, 1878	6226	10.835	31.0	20.8	33 1 54.7	−14 10.6	− 1.8	....	42.3
	6642	37.679	18.2	34.0					
	6647	38.743	18.0	34.0					
	....	8.988	37.0	16.0	32 42 43.9	+ 4 53.0	− 0.6	....	36.3
	....	26.919	35.6	17.0					
	6697	13.222	5.2	48.0					
	6723	41.553	26.4	27.2					
	6748	41.273	19.4	34.2	32 30 27.0	+17 14.0	− 2.4	....	38.6
	6772	7.983	30.6	23.4					
	6783	32.823	30.2	23.8	32 55 33.6	− 7 48.7	+ 2.2	....	47.1
	6799	17.734	22.0	21.4					
	6833	28.312	17.8	36.4	32 44 59.5	+ 2 42.2	− 2.2	....	39.5
	6852	23.089	33.0	21.4					
	6867	21.554	37.0	17.8	32 43 59.4	+ 3 42.7	− 3.2	....	38.9
	6893	28.725	12.6	42.0					
	6926	2.918	28.6	26.4	33 10 37.1	−22 52.9	− 2.2	....	42.0
	6934	47.118	22.8	32.0					
	6966	11.077	29.2	25.6	32 41 40.3	+ 6 0.1	− 2.0	....	38.4
	6986	32.533	20.0	35.0					
	6996	11.369	25.0	30.0					
	7022	39.444	24.0	31.4					
	....	21.300	29.0	27.0					
	7146	15.310	39.4	17.0	32 43 15.2	+ 4 27.2	− 0.8	....	35.6
	7149	19.475	39.0	18.0					
	7182	30.613	3.0	53+					
	7200	31.248	49.6	7.0					
	7220	21.556	33.0	39.4	32 43 22.6	+ 4 20.5	− 4.0	....	32 47 39.1
	7255	29.944	17.0	23.4					

a Micr. diff 4^{r}.764, not 5^{r}. *b* Micr. diff. 22^{r}.359, not 23^{r}. *c* Micr. diff .20^{r}.445, not 25^{r}. *d* Read ^{r}.588, not 13^{r}.

Observations and computations for latitude, Fort Bayard, N. Mex.—Continued.

Date.	Number of star.	Micrometer readings.	Level.		Half sum of declination.	Corrections.			Latit
			N.	S.		Micr. and refr.	Level.	Merid.	
					° ′ ″	′ ″	″		°
October 9, 1878	7275	25.262	21.8	35.4	32 46 20.5	+ 1 22.9	− 2.3	....	32 4
	7290	41.187	33.0	24.0					
	7333	9.044	32.0	25.0					
	7356	19.244	19.2	38.0					
	7402	8.522	34.0	23.4					
	7418	16.860	32.4	25.4	32 42 10.0	+ 5 31.3	− 5.7	....	
	....	21.529	18.4	39.0					
	7455	*a*27.973	18.0	39.8					
	....	32.033	14.8	43.6					
	7480	33.595	13.4	44.4					
	7544	38.716	20.4	37.8	32 33 41.1	+13 59.8	+ 0.6	....	
	7585	11.677	39.0	19.6					
	7598	23.255	34.0	24.0	32 44 23.6	+ 3 19.0	− 8.0	....	
	7606	29.664	11.0	46.8					
	7681	37.350	30.0	27.8	32 41 1.5	+ 6 41.4	− 0.8	....	
	7705	16.514	31.4	26.8					
	7712	14.006	25.6	32.6					
	7723	30.705	42.8	15.6	32 53 5.1	− 5 22.1	− 2.7	....	
	7759	20.334	11.0	47.0					
	7814	14.164	29.0	29.4	32 38 31.9	+ 9 8.8	− 1.1	....	
	7837	31.832	27.8	31.0					
	....	23.471	29.4	29.6	32 49 22.1	− 1 37.6	− 5.9	....	
	7914	26.612	20.0	38.8					
	7932	10.415	43.4	15.6	32 41 58.6	+ 5 42.8	− 0.2	....	
	7958	35.671	15.0	43.6					
	8023	38.854	44.0	15.6					
	8071	27.114	28.2	31.6	32 50 9.8	− 2 29.6	− 0.4	....	
	8083	22.208	31.0	28.8					
	8131	16.597	33.8	27.0	32 45 21.8	+ 2 19.8	− 0.7	....	
	8160	36.248	33.4	27.0					
	8229	21.922	26.0	35.0					
	8243	6.813	36.0	24.8	32 28 54.6	+18 43.5	+ 1.3	....	
	....	42.986	27.0	34.0					
	8300	31.425	15.8	45.0	32 40 5.8	+ 7 34.8	− 0.1	....	
	8322	15.339	45.0	16.0					
	8330	18.225							
	8	7.090	40.2	21.0	32 30 41.0	+16 57.9	− 5.3	....	
	....	39.863	12.4	48.6					
	58	36.500	27.0	34.0	32 36 7.1	+11 35.1	− 1.1	....	
	109	14.120	32.4	28.8					
	142	33.768	36.8	24.8	32 58 15.2	−10 32.7	+ 2.4	....	
	153	13.308	28.4	33.0					
	201	15.430	22.0	39.2	32 56 19.0	− 8 35.6	− 2.0	....	
	213	32.030	36.0	25.4					
	244	34.764	27.8	33.6	32 40 56.9	− 2 14.0	− 1.3	....	
	254	22.653	28.0	33.0					
	288	33.023	31.0	29.8					
	334	29.640	32.4	28.8	32 52 56.2	− 5 12.9	+ 0.1	....	32 4
	345	19.567	29.0	32.2					

a Read 22r.973.

Discussion of latitude, Fort Bayard.

Combination.	Number of observations.	Number of stars.	Latitude.	Correction to microm.	Combination.	Number of observations.	Number of stars.	Latitude.	Correction to microm.
			° ′ ″	″				° ′ ″	″
1	2	3	32 47 41.0	− 1.0	17	3	2	32 47 38.6	+ 1.5
2	3	4	38.2	+ 0.2	18	4	2	39.5	+ 0.6
3	4	2	38.2	+ 1.2	19	5	2	41.0	− 0.1
4	2	2	43.7	0.0	20	5	3	39.6	+ 0.3
5	4	2	40.3	+ 0.2	21	4	2	40.0	− 0.2
6	4	2	41.6	+ 0.3	22	5	3	40.0	+ 0.2
7	2	2	41.5	− 1.6	23	4	2	38.4	+ 1.3
8	5	5	40.0	+ 0.5	24	4	3	39.8	+ 0.5
9	5	*4	40.5	+ 0.3	25	5	2	38.0	+ 1.2
10	4	2	41.7	+ 0.3	26	5	2	39.7	+ 0.8
11	5	*6	40.2	+ 0.1	27	5	2	41.4	− 0.7
12	5	2	40.6	+ 0.4	28	2	2	39.8	− 0.5
13	5	2	39.7	+ 1.0	29	2	3	41.4	− 0.6
14	5	3	39.2	+ 0.2	30	2	4	40.8	0.0
15	5	2	40.5	+ 0.5	31	2	2	41.1	− 0.4
16	3	2	40.1	− 0.4					

Final latitude: 32° 47′ 40″.35 ± 0″.18.

In this station's work it was found that the levels were uncertain. Hence a correction was applied to each result as given in the table of details to reduce to the constant level values for the several nights:

October 4, + 0″.1.
October 6, — 1″.4.
October 7, — 2″.6.
October 8, — 1″.4.
October 9, — 1″.6.

That is, the two observations of combination 1, October 8 and 9, where level corrections in the tables of details are + 2″.5 and — 1″.8, respectively, receive the corrections — 3″.9 and + 0″.2, reducing to — 1″.4 and — 1″.6. In this way the agreement of the pairs (see above) is much improved; but the probable error of final latitude is calculated allowing for the probable error ± 0″.12, derived from the table just preceding, and ± 0″.14 uncertainty of the mean of levels for five nights.

The following table comprises the latitudes of a number of points at which sextant observations were made during 1878, and the subsequent computations by officers of the survey, during the office season, viz:

Geographical positions from sextant observations, variations of needle, altitudes, &c., for the year 1878.

Year.	Station.	State or Territory.	Atlas sheet.	Objects observed.	Latitude.	Altitude above sea-level.	Variation of the needle east.	Observer.	Computer.	Remarks.
					° ′ ″	*Feet.*	° ′			
1878	Rabbit Creek	Oreg.	29*d*	α Cygni α Bootis Polaris	42 29 00.3	5337.4	....	Lieut. Symons	J. C. Spiller	
1878	Abert Lake	Oreg.	29*d*	α Bootis Polaris	42 44 40.4	4296.7	18 55	Lieut. Symons	J. C. Spiller	North end.
1878	Foster's Ranch, west shore of Summer Lake.	Oreg.	29*c*	β Pegasi α Bootis Polaris Altair	42 47 21.7	4174.3	18 07	Lieut. Symons	J. C. Spiller	Pass over Rim Rocks.
1878	Sykan Marsh	Oreg.	29*c*	β Pegasi α Coronæ Borealis Polaris Altair	42 42 43.3	4959.9	....	Lieut. Symons	J. C. Spiller	Southern end.
1878	Camp 12, spring on Oregon Central Military Road.	Oreg.	29*c*	β Pegasi α Coronæ Borealis Polaris Altair	42 30 12.5	5508.7	18 13	Lieut. Symons	J. C. Spiller	
1878	Four-mile Lake	Oreg.	29*c*	α Andromedæ α Coronæ Borealis Polaris Altair	42 26 43.35	5610.2	18 19	Lieut. Symons	J. C. Spiller	
1878	Fort Klamath	Oreg.	29*c*	α Andromedæ α Coronæ Borealis Polaris Altair	42 41 08.0	4106.4	19 41	Lieut. Symons	J. C. Spiller	
1878	Camp 21, on Williamson's River.	Oreg.	29*c*	α Andromedæ α Coronæ Borealis Polaris Altair	42 44 40.2	4206.6	....	Lieut. Symons	J. C. Spiller	
1878	Camp 24	Oreg.	29*a*	α Coronæ Borealis Polaris Altair	43 21 37.8	4566.7	18 56	Lieut. Symons	J. C. Spiller	On headwater stream of Deschutes River, southeast of Diamond Peak.
1878	Summit Lake	Oreg.	28*b*	α Coronæ Borealis Polaris Altair	43 27 30.4	5630.1	19 22	Lieut. Symons	J. C. Spiller	Camp west of.

1878	Odell Lake	Oreg	28b	α Andromedæ α Coronæ Borealis Polaris Altair	43	36	15.5	5483.7	18	25	Lieut. Symons	J. C. Spiller	Camp north of.
1878	Davis Lake	Oreg	20a	α Andromedæ α Coronæ Borealis Polaris Altair	43	38	25.4	4466.0	....		Lieut. Symons	J. C. Spiller	Camp north end of.
1878	Farewell Bend, ford of Deschutes River.	Oreg	20c	α Pegasi α Coronæ Borealis Polaris Altair	44	03	47.6	3620.9	19	34	Lieut. Symons	J. C. Spiller	
1878	Tygh Valley	Oreg	20a	α Pegasi α Coronæ Borealis Polaris Altair	45	14	38.4	1088.8	17	05	Lieut. Symons	J. C. Spiller	
1878	Fifteen-mile Creek	Oreg	20a	α Pegasi ζ Hercules Polaris Altair	45	26	58.5	1266.7	19	29	Lieut. Symons	J. C. Spiller	Dufur's Ranch.
1878	Langton's Ranch	Oreg	29a	γ Pegasi α Lyræ Polaris ε Pegasi	43	35	09.8	5162.7	18	45	Lieut. Symons	J. C. Spiller	Water holes; Great Oregon Desert.
1878	Silver Lake	Oreg	29c	α Lyræ Polaris	43	06	54.8	....	....		Lieut. Symons	J. C. Spiller	Durand's Ranch.
1878	Chewaucan Valley, south and upper valley.	Oreg	29d	γ Pegasi Altair Polaris ε Pegasi	42	32	05.0	4336.0	18	27	Lieut. Symons	J. C. Spiller	Moss' Ranch.
1878	Cress' Ranch, near	Cal	47a	Arcturus α Cygni α Ophiuchi Polaris Sun	39	52	00.1	5157.0	17	38	Lieut. Tillman	Lieut. Griffin	Camp 9.
1878	Quincy, near	Cal	47a	Arcturus α Cygni Polaris Sun	39	56	04.2	3381.0	17	20	Lieut. Tillman	Lieut. Griffin	Camp 10.
1878	Taylorsville, near	Cal	47a	Arcturus α Cygni Polaris Sun	40	04	59.4	3479.0	17	19	Lieut. Tillman	Lieut. Griffin	Camp 12.
1878	Camp 13	Cal	47a	α Cygni Arcturus Polaris	39	56	43.8	5607.3	17	03	Lieut. Tillman	Lieut. Griffin	Head of Grizzly Valley.
1878	Camp 27	Cal	47a	α Coronæ Borealis α Aquilæ Polaris	40	07	36.7	4989.7	18	40	Lieut. Tillman	Lieut. Griffin	Colby's Ranch.

Geographical positions from sextant observations, variations of needle, altitudes, &c.—**Continued.**

Year.	Station.	State or Territory.	Atlas sheet.	Objects observed.	Latitude.	Altitude above sea-level.	Variation of the needle east.	Observer.	Computer.	Remarks.
					° ′ ″	*Feet.*	° ′			
1878	Deer Creek Meadow	Cal	47*a*	Sun α Coronæ Borealis Polaris α Aquilæ Polaris	40 16 14.9	4518.1	16 40	Lieut. Tillman	Lieut. Griffin	On Lost Creek, one mile above junction with Deer Creek.
1878	Johnson's Ranch, near Susanville.	Cal	47*a*	ε Pegasi α Andromedæ α Lyræ	40 21 44.6	4378.8	18 50	Lieut. Tillman	Lieut. Griffin	Variation given for Susanville.
1878	Camp 32	Cal	47*a*	α Coronæ Borealis Polaris α Aquilæ	40 26 14.5	5816.0	18 41	Lieut. Tillman	Lieut. Griffin	Upper ranch on Warner Creek.
1878	Pine Creek	Cal	47*a*	α Andromedæ α Lyræ Polaris ε Pegasi	40 35 00.2	5409.1	18 45	Lieut. Tillman	Lieut. Griffin	At ranch at upper end of flat.
1878	Camp 51	Cal	47*a*	ε Pegasi Polaris α Lyræ	40 37 49.9	5303.2	16 26	Lieut. Tillman	Lieut. Griffin	Six miles north of Cinder Cone.
1878	Ogburn's Ranch	Cal	47*a*	ε Pegasi Polaris α Lyræ	40 30 15.4	2269.5	16 45	Lieut. Tillman	Lieut. Griffin	
1878	West Point	Cal	56*b*	α Ophiuchi Altair Polaris η Ursæ majoris	38 23 56.9	2773.7	16 47	Lieut. Macomb	Lieut. Griffin	
1878	Antelope	Cal	56*b*	α Ophiuchi Altair α Coronæ Borealis Polaris	38 30 31.0	4272.5	16 49	Lieut. Macomb	Lieut. Griffin	
1878	Half-way House	Cal	56*b*	α Coronæ Borealis Polaris Markab Altair	38 11 57.8	3358.5	16 33	Lieut. Macomb	Lieut. Griffin	
1878	Gold Spring Ranch	Cal	56*b*	α Coronæ Borealis Altair Markab Polaris	38 02 45.3	1938.5	16 47	Lieut. Macomb	Lieut. Griffin	

1878	Strawberry, Sonora Road.	Cal	50b	Markab α Ophiuchi Polaris	38	11	30.3	6237.8	....		Lieut. Macomb..	Lieut. Griffin...	
1878	Hetch-Hetchy Valley.....	Cal	56b	ε Pegasi Polaris α Persei	37	57	17	3437.3	....		Lieut. Macomb..	Lieut. Griffin...	
1878	Ojo San Nicholas		84d	Sun Polaris Altair	32	35	25.5	4218.0	11	29	Lieut. Griffin....	Lieut. Griffin...	
1878	Silver Spring, Sacramento Mountains.	[illegible]	84d	Polaris	33	01	48.9	7638.2	13	11	Lieut. Griffin....	Lieut. Griffin...	
1878	Peñasco Creek............	[illegible]	84d	Sun Polaris	32	49	14.5	6486.6	12	55	Lieut. Griffin....	Lieut. Griffin...	
1878	Fort Klamath............	[illegible]	29c	Altair α Coronæ Borealis Polaris	42	41	07.7	4108.4	19	41	Lieut. Symons ..	M. Rock.......	
1873	Fort Grant...............	[illegible]	83c	α Arietis Altair α Coronæ Borealis γ Pegasi Polaris	32	36	56.7	4833.1	13	49	Lieut. Russell...	M. Rock........	Mean of two nights

The executive report of Professor Safford, who occupied the obs tory at Ogden, Utah, appears as Appendix H.

Assistant John H. Clark presents a brief account of his occupa three of the five main stations. (See Appendix I.)

While *en route* to his field of duty in Southern New Mexico, Assi Miles Rock found himself at Santa Fé, N. Mex., within the line of sh of the total solar eclipse of July 27, 1878; his observations are not his brief report. (See Appendix J.)

It had been intended to make brief mention of the use of the obs tory by the French commission of astronomers sent to observe the tr of Mercury of May 6, 1878, in the report of that year. The party sisted of Prof. Charles André, director of the Observatory of Ly Alfred Angôt, professor of physics in the Lycée Fontanes, Paris, Monsieur Hatt, hydrographic engineer of the French navy. The ob atory and its appurtenances were placed at the disposal of these ge men, and such assistance as was practicable was rendered by Assi Francis Klett and Sergeant Hoffmann, Fourteenth Infantry. The mission were present in Ogden from April 2 to May 11, and whil observations were not wholly successful, a considerable number of p graphs of the different phases of the transit were secured. The of report showing the results of these observations is awaited with i interest.

GEODETIC AND TOPOGRAPHICAL.

Five bases have been measured in the vicinity of the following po 1, Austin, Nev.; 2, Fresno, Cal.; 3, Dalles, Oreg.; 4, Fort Bliss, Te 5, Fort Bayard, N. Mex., and the development made therefrom in instance.

AUSTIN AUXILIARY BASE.

This line was located about 1 mile northeast by east from Austin. was measured for the purpose of connecting the astronomical monu at Austin with Mount Prometheus. The line was measured but onc Lieutenant Ludlow and Mr. Klett. The measurement was mad stakes driven into the ground and aligned for the purpose; the diffe of level for each fifty feet was obtained by using the same stakes as tions. The measured length of the line was 500 feet.

FRESNO BASE.

This line was located about 5 miles east of Fresno. It was t measured with a compensated steel-tape line (Stackpole make); the was daily twice compared with standard rods. The measurement made on stools 3 feet above the ground. These stools were centere plumb-lines over a wire 600 feet long, which was tightly stretche the direction of the base line. The two measurements were mad Lieutenant Ludlow, Mr. Klett, and Mr. Bailey, and differed by 0.3 the mean length being 22,227.04 feet. The line was leveled by Mr. K the distance between the level stations depending upon the natu the ground.

DALLES BASE.

The base line at the Dalles was selected by Lieutenant Symons, was located northwest of the town. It was twice measured with a St pole compensated steel tape, the two measures differing by 0.3 feet. first measurement was made by Lieutenant Symons and Mr. Kal the second was made by Mr. Kahler. The line was leveled by

Kahler, the triangulation instrument being used for the purpose. Stakes were driven every 50 feet and measures made upon these as were also the levels. The measurement reduced for level and elevation above the sea gives for the adopted length of the base, at sea-level, 8,639.974 feet. The ends of the base were marked by iron pins driven into the ground. For the purpose of development large wooden frames were erected over the ends of the line, but were not intended to be permanent.

FORT BLISS BASE.

This line was laid out on a nearly level plain about 5 miles east of Franklin, Tex. The ends were marked by cross-lines on copper tacks driven into large wooden pegs which were firmly set in the ground. The line between the ends was carefully grubbed of the small bushes, and was made as smooth as possible. It was also leveled and a correction determined to the measured distance. The measurements, two in number, were made with a compensated 50-feet steel tape by Stackpole, which was set at 90°, the difference between the actual and set temperatures at each 1,000 feet being noted and the corresponding corrections computed. The ends of each 50 feet were marked by pins stuck in board boxes which were firmly fixed by means of long iron nails which were pressed into the earth. The results were as follows:

	Feet.	Temp. cor. feet.	Level cor. feet.	Feet.
First measurement by Maxson & Walbridge	8,049.689	+ 0.632	– 0.020	= 8,050.291
Second measurement by Griffin & Maxson	8,049.789	+ 0.512	– 0.020	= 8,050.271
Mean				8,050.281
Reduction to sea-level				1.321
Length of base at sea-level				8,048.960

BAYARD BASE.

Was measured on the plain west of the Santa Rita Mountains, near the warm springs of Apache Tejo. The line was twice measured by Mr. Nell and his assistant Mr. Gillette, and leveled by the latter. The measurement was made with a Stackpole compensated steel-tape line of 50 feet length.

The first measurement gave 27,265.968 feet.
The second measurement gave 27,265.906 feet.

The separate lengths of the line were marked by pins on boards placed at the proper distances for the purpose. The temperature of the tape was recorded every 1,000 feet and adjusted at the same intervals. The ends of the line were marked by wooden poles 6 inches in diameter. These marks were not intended to be permanent.

A triangulation has been extended over the area occupied by each party connecting with that of previous years, except the larger area traversed by the two divisions of party 1, California section, about 18,000 square miles, that in one season could only be fairly reconnoitered for the best selection of points. More than ordinary care has been observed in selecting the best points and in multiplying observations.

The area covered topographically has been approximately 26,550 square miles, and is distributed in the following basins of drainage:

The northwestern arm of the "Great Interior Basin." The basin of the Upper Klamath River, and the basin of the Columbia contiguous to and east of the Cascade Range. In the mountain basins at the head waters of the Tuolumne, Stanislaus, Merced, and Feather Rivers, all of which are tributary to the inland valleys of California. A portion of th area also fell in the basin of the Rio Grande.

The elevations above sea at which the work has been carried on va from 171 feet as the lowest to 14,000 feet, being White Mountain Pea Nevada, as the highest. Land classification data have been secur incidentally to the progress of the work. Magnetic observations ha been secured at all prominent points. As usual, connection has bee made with boundary monuments and stakes of the United States lan survey where the latter were found. The special survey of the Gre Salt Lake and vicinity has been completed so far as relates to its mea der and that of the islands, and their contour with numerous soundin and observations for surface evaporation have been made. In order t complete the triangulation and topography of certain atlas shee already entered upon, viz, 20 A, 20 C, 29 A, 29 C, 38 B, 56 D, 73, 52 I 80 B, 84 D, 90 A, and 90 C, it will be necessary that a number of sma parties shall take the field during a subsequent season to fill gaps. (Se statement at end of office estimate.)

The route followed by myself during the season of 1878 was fro Reno, on the Central Pacific Railroad, to Camp Bidwell, Cal.; thence t Fort Klamath, Oreg.; thence northward to the Dalles, on the Columb River, and eastward to Walla Walla, in Washington Territory.

This gave me an opportunity to see the northwestern arm of the gre interior basin and its approach to the Cascade Range, the relatio between the northern Sierras and the former range, and to scan larg interior areas east of the Cascades, to note the extremely desert-li appearance of Northwestern Nevada, and to encompass as well with one season's observations a transit of the luxurious valley of the Wi lamette; and thus desert, valley, mountain, and plain were cursori examined, and an opportunity afforded to contrast this section with th of like altitudes visited in other field seasons at lower latitudes, and t select elevated geodetic stations to the eastward of the Cascades, to b occupied in the development of a network of triangles, extending fro the Central Pacific Railroad to the Columbia River, and covering larg parts of California, Nevada, and Oregon.

Other than this brief mention will be left to volume 1, soon forthcom ing, that treats somewhat systematically the area visited by myse during the several expeditions.

The lines of the earlier explorers—Frémont, Williamson, and Al bott—along the east base of the Cascades were followed in part, an scenes made familiar by their writings recognized. This section i still an almost untrodden wilderness, unbroken save now and then b the presence of an adventurous ranchman and stock-raiser, changing however, as one nears the Columbia River, where, at intervals of neve less than 5 miles, a few small farming settlements appear.

Geographical positions of military posts.

No.	Name of post.	Latitude.			Longitude.			Altitude above sea level.	Magnetic declination, with date of determination.				Remarks.
		°	′	″	°	′	″	*Feet.*	°	′	″		
1	Apache, Fort, Arizona	33	47	18.70	109	57	(†)	5,000.9	14	10	42	1871	Latitude by sextant.
2	Bayard, Fort, New Mexico (astronomical monument)	32	47	41.	108	09	08.	6,098.0	12	56	00	1878	Not final. Longitude by telegraph and transit. Latitude by zenith telescope.
3	Bidwell, Fort, California (flagstaff)	41	51	30.94	120	09	15.56	4,647.0	17	53	00	1877	Trigonometrical connection with triangulation.
4	Bliss, Fort, Texas (astronomical monument)	31	45	31.	106	29	05.	3,623.	12	25	15	1878	Not final. Longitude by telegraph and transit. Latitude by zenith telescope.
5	Bowie, Fort, Arizona	32	10	16.2	(not reduced.)			4,871.6	13	47	53	1873	Latitude by sextant.
6	Cameron, Fort, Utah (the first building erected, 1872)	38	16	53.34	111	44	00.31	6,057.7	16	24	00	1873	Trigonometrical connection with triangulation.
7	Cheyenne Depot, Wyoming	41	07	57.77	104	49	11.65	6,041.0	......			......	Trigonometrical connection with Cheyenne astronomical monument. Altitude of astronomical monument.
8	Craig, Fort, New Mexico (flagstaff)	33	38	00.99	107	01	7.96	4,447.5	12	59	09	1873	Trigonometrical connection with triangulation.
9	Douglass, Fort, Utah (astronomical monument)	40	45	47.58	111	50	14.07	4,905.	17	01	00	1872	By traverse line to Coast Survey station at Salt Lake City.
10	Ellis, Fort, Montana (flagstaff)	45	40	13.45	110	58	30.97	......	19	13	00	1877	Trigonometric connection with astronomical monument at Bozeman. Magnetic declination for Bozeman.
11	Fred Steele, Fort, Wyoming (flagstaff)	41	46	50.63	106	56	54.27	6,850.0*	16	27	10	1873	Trigonometric connection with astronomical monument.
12	Garland, Fort, Colorado (flagstaff)	37	25	27.33	105	25	33.73	7,937.0*	14	07	08	1873	Trigonometric connection with triangulation.
13	Grant, Fort, Arizona	32	36	56.7	......			4,833.1	13	49	00	1873	Latitude by sextant.
14	Hall, Fort, Idaho (flagstaff)	43	08	54.8	......			4,752.1	18	13	00	1877	Latitude by sextant.
15	Halleck, Fort, Nevada	40	48	34.35	115	19	34.05	5,789.7	16	21	24	1869	Longitude by telegraph and sextant. Latitude by sextant.
16	Klamath, Fort, Oregon	42	41	07.7	......			4,108.4	19	41	00	1878	Latitude by sextant.
17	Marcy, Fort, Santa Fé, N. Mex. (astronomical monument).	35	41	19.29	105	56	45.22	6,965.2	13	09	32	1874	Longitude by telegraph and transit. Latitude by zenith telescope.
18	Mohave, Fort, Arizona	35	02	09.	114	35	54.	755.8	14	45	00	1875	By connection with iron monument of the California boundary.
19	North Platte Station, Nebraska (astronomical monument).	41	08	18.33	100	45	53.14	2,789.0	......			......	Longitude by telegraph and transit. Latitude by zenith telescope.
20	Russell, Fort D. A., Wyoming (flagstaff)	41	08	38.83	104	50	24.47	6,041.0	......			......	Trigonometrical connection with Cheyenne astronomical monument. Altitude of the astronomical monument.
21	Sanders, Fort, Wyoming (flagstaff)	41	17	26.89	105	34	59.56	7,168.0*	15	30	00	1873	Connection by traverse line with the astronomical monument at Laramie City.
22	Sidney, Fort, Nebraska (astronomical monument)	41	08	36.75	102	58	13.32	4,106.3	......			......	Longitude by telegraph and transit. Latitude by zenith telescope.
23	Stanton, Fort, New Mexico (flagstaff)	33	29	35.72	105	31	59.72	6,151.5	12	24	00	1878	Trigometrical connection with triangulation.
24	Union, Fort, New Mexico (astronomical monument)	35	54	24.86	105	00	51.15	6,744.1	14	40	00	1874	Longitude by telegraph and transit. Latitude by zenith telescope.

* The altitudes marked with an asterisk are from railroad levels, all others from barometric determinations. † Approximate.

Geographical positions of military posts—**Continued.**

No.	Name of posts.	Latitude.			Longitude.			Altitude above sea level.	Magnetic declination, with date of determination.			
		°	′	″	°	′	″	Feet.	°	′	″		Remarks.
25	Verde, Fort, Arizona	34	34	20.19	111	58	(*)	3,159.7	....			......	Latitude by sextant.
26	Whipple Barracks, Arizona	34	33	06.12	112	27	10.20	5,318.0	....			......	Longitude by lunar culminations. Latitude by zenith telescope.
27	Wingate, Fort, New Mexico (flagstaff)	35	28	49.47	108	33	20.(*)	6,962.1	14	51	27	1878	Latitude by sextant.

* Approximate.

List of Triangulation Stations.

Name of peak.	State or Territory.	Atlas sheet.	Latitude.	Longitude.	Altitude.	Remarks.
			° ′ ″	° ′ ″		
Primary triangulation stations:	....	56	....	....	....	Triangulation sheet No. 8.
Pyramid	California	56*b*	38 50 34	120 9 19	10, 127. 1	
Freel's	do	56*b*	38 51 19	119 53 50	10, 848. 9	
Silver Lake	Nevada	56*b*	38 51 45	119 28 34	....	
Elephant	California	56*b*	38 39 40	119 59 54	10, 418. 9	
Mokelumne	do	56*b*	38 32 9	120 5 30	9, 467. 2	
Highland	do	56*b*	38 32 28	119 45 10	10, 955. 6	
Sweetwater	do	56*b*	38 26 3	119 18 7	11, 778. 1	
Sonora	do	56*b*	38 21 4	119 37 57	11, 478. 7	
Conness	do	56*d*	37 57 51	119 19 6	12, 518. 4	
Hoffmann	do	56*d*	37 50 39	119 30 28	10, 871. 7	
Moccasin	do	56*d*	37 48 8	120 19 34	2, 971. 3	
Clark	do	56*d*	37 41 36	119 25 33	11, 266. 0	
Devil's	do	56*d*	37 31 34	119 44 17	6, 909. 9	
Schultz	do	56*d*	37 26 33	120 8 33	2, 275. 2	
Chiquito	do	56*d*	37 20 47	119 25 32	8, 136. 2	
Lyell	do	56*d*	37 44 11	119 16 7	13, 190. 7	
Secondary triangulation stations:	....	56	....	....	....	Do.
Stevens'	California	56*b*	38 43 53	119 58 44	10, 011. 3	
Cary's	do	56*b*	38 44 10	119 52 11	9, 970. 2	
Dunderberg	do	56*d*	38 3 43	119 16 17	12, 289. 2	
Wade's	do	56*d*	37 51 9	119 47 17	7, 153. 5	
Engineer	do	56*d*	37 49 55	119 23 35	11, 231. 4	
Cloud Rest	do	56*d*	37 45 53	119 29 12	9, 772. 5	
Merced	do	56*d*	37 37 55	119 23 31	11, 413. 3	
Pilot	do	56*d*	37 45 36	119 56 1	....	
Primary triangulation stations:	....	57	....	....	....	Do.
Basalt	Nevada	57*a*	38 59 10	118 25 59	6, 599. 2	
Paradise	do	57*b*	38 48 16	117 49 23	8, 662. 4	
Poston	do	57*b*	38 49 49	117 20 56	11, 977. 7	
Cory	do	57*a*	38 33 57	118 47 16	11, 326. 0	
Dana	California	57*c*	37 53 49	119 13 5	....	
McBride	do	57*c*	37 50 8	118 21 13	13, 442. 7	
White Mountain	do	57*c*	37 37 51	118 15 8	....	
Morgan	do	57*c*	37 24 7	118 43 47	....	
Primary triangulation stations:	....	64	....	....	....	Do.
Green Mountain	California	64*b*	37 15 44	119 59 20	1, 351. 7	
Deadwood	do	64*b*	37 18 37	119 41 00	4, 451. 3	
Primary triangulation stations:	....	65	....	....	....	Do.
Waucoba	California	65*a*	37 1 8	118 0 23	11, 267. 1	
New York Butte	do	65*a*	36 38 41	117 55 56	....	
Whitney	do	65*a*	36 34 33	118 17 32	14, 448. 4	
Olancha	do	65*c*	36 15 44	118 7 10	12, 250. 8	
Maturango	do	65*d*	36 6 56	117 29 50	*8, 844	
Sunday	do	65*c*	35 46 48	118 35 17	8, 334. 8	
Owen's	do	65*c*	35 44 5	118 0 0	....	
Telescope	do	65*d*	36 9 52	117 5 27	*10, 937	
Wahguyhe	do	65*b*	36 56 4	117 6 16	*8, 527. 9	
Secondary triangulation stations:	....	65	....	....	....	Do.
Corcoran	California	65*a*	36 31 14	118 14 24	14, 093. 7	
Thunder	do	65*c*	36 4 52	118 34 41	9, 121. 7	
Primary triangulation stations:	....	32	....	....	....	Triangulation sheet No. 11.
Big Butte	Idaho	32*a*	43 23 42	113 1 38	7, 658. 7	
Mount Pisgah	do	32*d*	43 5 34	111 18 58	9, 694. 6	
Mount Putnam	do	32*d*	42 57 8	112 10 10	8, 905. 3	
Meade	do	32*d*	42 29 41	111 15 11	10, 540. 9	
Elkhorn (north point).	do	32*d*	42 20 0	112 19 56	....	
Secondary triangulation stations:	....	32	....	....	....	Do.
Pillar Butte	Idaho	32*c*	42 52 58	113 13 9	5, 301. 1	
Badger	do	32*c*	42 33 1	113 4 1	6, 389. 0	
Bannock	do	32*c*	42 36 9	112 42 43	8, 358. 9	
South Putnam	do	32*d*	42 55 3	112 7 58	....	
Cedar Creek	do	32*c*	42 26 46	113 3 35	7, 586. 5	
Deep Creek	do	32*c*	42 28 13	112 39 38	8, 817. 6	
Sedgwick	do	32*d*	42 30 54	111 55 40	9, 207. 2	

List of Triangulation Stations—Continued.

Number.	Name of peak.	State or Territory.	Atlas sheet.	Latitude.	Longitude.	Altitude.	Remark
				° ′ ″	° ′ ″		
58	Sherman	Idaho	32*d*	42 27 52	111 33 11	9,572.6	Triangulatio No. 11.
	Primary triangulation stations:		40				Triangulatio No. 12.
59	Pilot Knob	Nevada	40*d*	41 1 12	114 4 52	10,758.3	
60	Desert	Utah	40*d*	40 57 2	113 47 36	8,175.4	
	Primary triangulation stations:		41				Do.
61	Cache	Idaho	41*a*	42 11 4	113 39 55	10,451.2	
62	Black Pine	do	41*a*	42 7 8	113 7 28	9,386.0	
63	Clear Creek	Utah	41*a*	41 41 23	113 44 44	9,132.1	
64	Blue Spring	do	41*a*	41 47 36	112 32 54	7,131.4	
65	Naomi	do	41*b*	41 54 39	111 40 46	9,951.0	
66	Tangent	do	41*c*	41 28 51	113 10 42		
67	Promontory	do	41*c*	41 29 22	112 30 45	7,459.7	
68	Newfoundland	do	41*c*	41 11 7	113 22 19	7,045.5	
69	North Ogden	do	41*d*	41 21 45	111 57 53	9,695.7	
70	Observatory	do	41*d*	41 11 57	111 53 10	9,589.2	
71	Antelope Island	do	41*d*	40 57 40	112 13 12	6,660.1	
	Secondary triangulation stations:		41				Do.
72	Oxford	Idaho	41*b*	42 16 8	112 6 5	9,386.0	
73	Castle Rock	do	41*b*	42 12 9	111 33 8	9,610.9	
74	Kimball's	Utah	41*b*	41 57 40	111 13 57	7,777.7	
75	Black Butte	do	41*b*	41 55 36	112 7 37		
76	Box Elder	do	41*b*	41 38 6	112 1 7	9,541.8	
77	South Promontory	do	41*c*	41 18 22	112 27 5		
78	Barton	do	41*d*	41 4 52	111 51 20	9,854.2	
79	Porcupine	do	41*d*	41 1 7	111 7 7		
	Primary triangulation station:		50				Do.
80	West Twin	Utah	50*b*	40 35 44	111 43 42		
	Primary triangulation stations:		38				Triangulation No. 7.
81	Lo-lo-che-wis	Oregon	38*a*	42 18 22	120 37 38	7,957.2	
82	Sugarloaf	do	38*b*	42 17 58	120 7 12	8,415.6	
83	Cedar	California	38*b*	41 36 32	120 16 0	8,308.1	
84	Warren	do	38*d*	41 22 39	120 12 59	9,668.0	
85	South Fork	do	38*d*	41 9 14	120 33 39	7,408.6	
86	Division	Nevada	38*d*	41 5 46	119 15 32	8,584.7	
87	Mahogany	do	38*d*	41 1 26	119 33 18	8,363.1	
88	Granite	do	38*d*	40 47 22	119 25 48	8,990.1	
89	Observation	California	38*d*	40 46 22	120 10 7	8,009.3	
90	Fredonyer	do	38*d*	40 41 11	120 35 44	7,995.2	
	Secondary triangulation stations:		38				Do.
91	North End	Oregon	38*b*	42 3 54	120 14 13	8,471.6	
92	Bidwell	California	38*b*	41 56 52	120 7 50	8,551.2	
93	Camp Bidwell Flagstaff.	do	38*b*	41 51 31	120 9 16	4,647.0	
94	Yellow Mesa	Nevada	38*b*	41 50 5	119 37 16		
95	"49"	do	38*b*	41 33 24	119 55 23	7,498.0	
96	Alturas Hill	California	38*d*	41 28 57	120 32 43	4,459.5	
97	Eagle	do	38*d*	41 16 56	120 11 51	9,933.6	
98	Hat	do	38*d*	41 3 57	120 5 48	7,676.1	
99	McDonald	do	38*d*	40 56 23	120 24 36	7,954.0	
	Primary triangulation station:		39				Do.
100	Piute	Nevada	39*c*	41 16 43	119 3 23	8,618.2	
	Primary triangulation stations:		47				Do.
101	Lassen's Butte	California	47*a*	40 29 12	121 30 10	10,437.0	
102	Hot Springs	do	47*b*	40 22 25	120 7 7	7,692.1	
103	Thompson	do	47*b*	40 15 34	120 33 17	7,752.2	
104	To-ha-kum	Nevada	47*b*	40 10 40	119 27 7	8,174.0	
105	Ingalls'	California	47*b*	39 59 33	120 37 29	8,471.5	
106	Summit	do	47*d*	39 42 4	120 8 25	8,310.9	
107	Downieville Butte	do	47*c*	39 35 30	120 38 39	8,541.1	
108	Peavine	Nevada	47*d*	39 35 7	119 55 44	8,281.0	
109	Castle	California	47*d*	39 21 48	120 20 47	9,013.6	
110	Rose	Nevada	47*d*	39 20 30	119 54 54	10,820.3	
111	Twin	California	47*d*	39 6 37	120 13 47	8,823.9	
	Primary triangulation stations:		73				Triangulatio No. 9.
112	McGill	California	73*c*	34 48 44	119 8 52	*9,214	
113	Tehachapai	do	73*a*	35 2 21	118 34 35	*8,056	

List of Triangulation Stations—Continued.

Name of peak.	State or Territory.	Atlas sheet.	Latitude.	Longitude.	Altitude.	Remarks.
			° ′ ″	° ′ ″		
San Fernando	California	73*e*	34 19 39	118 36 2	3, 792. 8	Triangulation sheet No. 9.
Saddle, (Malaga)	do	73*e*	34 4 33	118 39 17	2, 896. 6	
Sister Else, (Station L)	do	73*c*	34 16 50	118 14 20		
San Gabriel	do	73*c*	34 14 27	113 5 54	6, 232. 0	
San Antonio	do	73*d*	34 17 6	117 39 14	10, 191. 9	
Grizzly	do	73*d*	34 5 53	116 50 55	11, 723. 4	
Pilot Knob	do	73*b*	35 23 32	117 13 50	5, 525. 1	
Secondary triangulation stations:		73				Do.
Camp Weldon	California	65*c*	35 40 1	118 17 5	2, 716. 9	
Cook's Point	do	73*a*	35 37 9	118 26 30	*6, 336	
Disappointment	do	73*e*	34 14 50	118 6 55		
Nichols's Point	do	73*a*	35 37 0	118 18 5	*6, 263	
Pabute	do	73*a*	35 28 37	118 21 50	8, 342. 0	
Tehachapai Double	do	73*a*	35 1 47	118 29 25	*8, 263	
White Granite	do	73*c*	34 36 34	119 7 55	7, 045. 0	
Workman's Hill	do	73*c*	34 0 48	118 1 14	1, 363. 7	
Primary triangulation stations:		80				Do.
San Jacinto	California	80*b*	33 48 59	116 42 16	10, 987. 3	
Temescal (1)	do	80*b*	33 42 31	117 32 4	*5, 730	
Secondary triangulation station:		80				Do.
San Pedro Hill	California	80*a*	33 44 39	118 20 8	1, 462. 3	
Primary triangulation stations:		61				Triangulation sheet No. 19.
Blanco	Colorado	62*c*	37 34 37	105 28 57	14, 269. 9	
Del Norte	do	61*d*	37 28 58	106 25 53	13, 084. 1	
Dunn's	do	61*c*	37 50 24	108 5 37	13, 502. 4	
Hunt's	do	61*b*	38 25 20	106 13 18	14, 054. 6	
La Plata	do	61*c*	37 26 41	108 5 10	13, 316. 0	
Mear's	do	61*c*	38 1 50	107 54 23	13, 008. 9	
Pagosa	do	61*c*	37 26 37	107 3 50	12, 675. 8	
Simpson	do	61*c*	37 40 46	107 23 22	14, 055. 9	
Uncompahgre	do	61*c*	38 4 18	107 27 33	14, 408. 4	
Secondary triangulation stations:		61				Do.
Æolus	Colorado	61*c*	37 37 39	107 36 15	*14, 211. 0	
Agency Knob	do	61*b*	38 16 24	106 51 54	12, 273. 5	
Bristol Head	do	61*c*	37 47 33	107 3 2	*12, 637. 7	
Buffalo	do	61*c*	37 36 24	107 29 27	13, 755. 5	
Canby	do	61*c*	37 46 54	107 30 50	13. 356. 0	
Carbon	do	61*a*	38 47 39	107 2 24	12, 078. 2	
Del Norte Hill	do	61*d*	37 40 14	106 21 26	8, 218. 3	
Elk	do	61*a*	38 43 4	107 11 47	13, 101. 6	
Engineer	do	61*c*	37 41 57	107 48 14	13, 277. 4	
Glacier	do	61*c*	37 50 21	107 59 20	14, 243. 0	
Grand Mesa	do	61*a*	38 53 34	108 10 26		
Handie	do	61*c*	37 54 46	107 30 6	14, 149. 0	
Horsefly	do	61*a*	38 11 43	107 55 40	10, 504. 5	
Leon	do	52*c*	39 4 45	107 50 27	11, 218. 4	
Macomb's	do	61*c*	37 34 25	106 58 43	13, 154. 2	
Meigs'	do	61*d*	37 21 1	106 41 39	13, 393. 5	
Observatory Cone	do	61*b*	38 34 41	106 51 37		
Pole Creek	do	61*c*	37 47 30	107 25 26		
Red Cloud	do	61*c*	37 56 27	107 25 8	14, 092. 6	
Sultan	do	61*c*	37 47 10	107 42 4	*13, 501. 0	
Wetterhorn	do	61*c*	38 3 38	107 30 29	*14, 062. 0	
Blaine's	do	61*c*	38 0 14	107 47 22	*14, 249. 0	
Primary triangulation stations:		69				Do.
Banded	Colorado	69*b*	37 6 16	106 37 27	12, 824. 4	
Las Truchas	New Mexico	69*d*	35 57 41	105 38 39	*13, 150. 0	
Santa Clara	do	69*d*	36 0 26	106 22 54	*11, 507. 0	
Santa Fé Baldy	do	69*d*	35 49 51	105 45 26	12, 661. 2	
Taos	do	70*a*	36 33 23	105 24 51	13, 097. 9	
Secondary triangulation stations:		84				Triangulation sheet No. 20.
Black	New Mexico	84*c*	32 54 23	108 10 8	8, 909. 8	
Caballo Cone	do	84*c*	33 6 1	107 14 3		
East Carrizo Cone	do	84*b*	33 39 0	105 37 17	7, 975. 7	
Horse	do	84*a*	33 58 36	108 7 50		
Organ	do	84*d*	32 20 41	106 34 6	*9, 108. 0	
Round	do	84*a*	33 40 26	108 6 28		
Sunday Cone	do	84*c*	32 37 6	107 27 14	6, 030. 3	

List of Triangulation Stations—Continued.

Number.	Name of peak.	State or Territory.	Atlas sheet.	Latitude.	Longitude.	Altitude.	Remarks.
				° ′ ″	° ′ ″		
	Primary triangulation stations:		89				Triangulation No. 21.
175	Hacheta	New Mexico	*89b*	31 37 56	108 24 18	8,352.3	
	Secondary triangulation stations:						Do.
176	Lalacha	New Mexico	*89b*	31 50 19	108 27 34		
	Primary triangulation stations:		90				Do.
177	Florida	New Mexico	*90a*	32 7 16	107 37 40	7,295.4	
178	Mexico	Chihuahua	*90b*	31 43 14	106 34 54		
179	North Franklin	Texas	*90b*	31 54 7	106 29 24	7,069.5	
180	South Franklin	do	*90b*	31 48 15	106 28 47		
	Secondary triangulation stations:						Do.
181	Boca Grande	Chihuahua	*90a*	31 37 46	107 59 59		
182	Boundary Monument		*90b*	31 46 58	106 32 1	4,443.8	
183	Graveyard Hill	Texas	*90b*	31 45 52	106 29 41		
184	Initial Monument		*90b*	31 46 58	106 31 34		
185	Potrillo	New Mexico	*90a*	31 55 21	107 4 7		
186	Rodadero	do	*90b*	31 47 11	106 32 32		
	Primary triangulation stations:		47				Triangulation No. 7.
187	Genoa	Nevada	*47d*	39 2 26	119 52 43		
188	Lyon	do	*47d*	39 7 33	119 28 12	8,793.5	
	Secondary triangulation stations:		47				Do.
189	Butt Mountain	California	*47a*	40 12 58	121 23 2	7,830.6	
190	Mount Dyer	do	*47a*	40 14 15	121 1 48	7,369.2	
191	Kettle Rock	do	*47a*	40 8 42	120 43 3	7,843.4	
192	Schaffer's	do	*47b*	40 26 43	120 21 18	6,864.5	
193	McKesick's	do	*47b*	40 5 23	120 14 43	7,083.0	
194	State Line	Nevada	*47b*	40 1 44	119 58 32	8,405.2	
195	Omjumi	California	*47b*	39 56 17	120 16 56	8,292.6	
196	Adams	do	*47b*	39 54 32	120 5 43	8,431.6	
197	Wellington	do	*47b*	39 52 0	120 31 41	7,664.6	
198	Haskell's	do	*47d*	39 39 41	120 33 1	8,126.4	
199	Crystal	do	*47d*	39 28 21	120 2 13		
200	N. E. Base	Nevada	*47d*	39 25 44	119 25 39	7,099.9	
201	Tibbie	do	*47d*	39 22 8	119 31 54	7,383.3	
202	Rocky Point	do	*47d*	39 20 50	119 34 2		
203	Davidson	do	*47d*	39 18 22	119 39 37	7,941.2	
204	Emma	do	*47d*	39 17 39	119 36 1	6,439.4	
205	McClellan	do	*47d*	39 15 26	119 41 46	7,531.6	
206	Raw	do	*47d*	39 11 56	119 28 40	8,403.8	
207	Como	do	*47d*	39 1 8	119 28 14	9,016.6	
208	Churchill Butte	do	*47d*	39 20 16	119 17 32	6,009.0	
	Primary triangulation stations:		48				Do.
209	Tutib	Nevada	*48c*	39 42 53	119 9 46	7,062.1	
210	Tarogqua	do	*48c*	39 34 52	118 13 54	8,771.7	
211	Grant	do	*48c*	39 32 16	117 54 56	9,964.8	
212	Desatoya	do	*48d*	39 21 47	117 45 19	9,921.3	
213	Bunker Hill	do	*48d*	39 15 2	117 7 18	11,404.5	
214	Fairview	do	*48c*	39 13 22	118 8 55	8,411.5	
	Secondary triangulation stations:		48				Do.
215	Emigrant	Nevada	*48d*	39 24 7	117 23 24	8,508.5	
216	Geneva	do	*48d*	39 21 27	117 4 14	11,077.1	
217	Birchim's	do	*48d*	39 8 53	117 28 33	10,343.9	
218	Cowles'	do	*48d*	39 3 14	117 33 25	9,980.1	
	Secondary triangulation stations:		76				Triangulation No. 20.
219	Alamocita	Arizona	*76d*	34 11 56	108 28 17		
	Primary triangulation stations:		77				Do.
220	Bernal Hill	New Mexico	*78a*	35 22 33	105 19 38		
221	Escobas	do	*77b*	35 32 2	105 42 45		
222	Ladrones	do	*77c*	34 26 1	107 5 29	9,214.3	
223	Manzano	do	*77d*	34 35 23	106 27 13	10,086.3	
224	Mosca	do	*77d*	34 48 36	106 24 34	9,723.0	
225	Osha	do	*77d*	34 38 9	106 26 44	10,022.8	
226	Pedernal	do	*77b*	34 50 38	105 39 4	7,580.3	
227	Placer	do	*77b*	35 20 3	106 10 36	8,965.2	
228	Rattlesnake Hill	do	*77d*	34 34 7	105 49 41	6,616.5	
239	Taylor	do	*77a*	35 14 16	107 36 55	11,391.2	
230	Tecolote	do	*77d*	34 4 37	105 41 44	7,253.7	
231	Tetilla	do	*77b*	35 36 24	106 13 1	7,060.0	

List of Triangulation Stations—Continued.

Name of peak.	State or Territory.	Atlas-sheet.	Latitude.	Longitude.	Altitude.	Remarks.
			° ′ ″	° ′ ″		
Primary triangulation stations:	....	83	....	....	....	Triangulation sheet No. 20.
Bear	New Mexico	83*d*	32 49 58	108 21 52	8, 081. 1	
Eagle	....do	83*b*	33 40 30	108 35 2	....	
Thomas	Arizona	83*b*	33 54 21	109 34 34	*11, 275	
Secondary triangulation stations:	....	....	....	....	....	Do.
Graham	Arizona	83*c*	32 41 56	109 52 40	10, 099. 5	
Primary triangulation stations:	....	84	....	....	....	Do.
Capitan	New Mexico	85*a*	33 35 24	105 16 20	10, 022. 9	
Colorado	....do	84*b*	33 50 42	106 42 6	5, 653. 7	
Cook	....do	84*c*	32 32 6	107 44 15	8, 329. 6	
Fra Cristobal	....do	84*a*	33 25 35	107 7 10	6, 646. 2	
Magdalena	... do	84*a*	33 59 23	107 11 39	10, 798. 0	
Nogal	....do	84*b*	33 29 47	105 48 36	9, 983. 0	
Salinas	... do	84*b*	33 17 51	106 32 15	9, 039. 5	
San Mateo	....do	84*a*	33 33 7	107 26 27	10, 208. 6	
Sierra Blanca	... do	84*b*	33 22 24	105 48 55	11, 892. 3	

e altitudes of all points marked thus (*) are from angles of elevation; all others are from barometric rminations.

BAROMETRIC HYPSOMETRY.

The usual plan for obtaining the vertical element of the greater share observation points by means of barometric differences in altitude has n pursued. The computations have been for another year under the ervision of Lieutenant Tillman. Satisfactory results have been obned. As heretofore, through the courtesy of General Myer, Chief nal Officer, transcripts of the observations of the Signal Service at cified points have been furnished. Lists of altitudes prepared by utenant Tillman of points of special importance in the areas of 1878 to be found herewith.

List of Altitudes.

Locality.	State or Territory.	Atlas-sheet.	Number of observations.	Reference station.	Altitude above sea-level.
					Feet.
Walla Walla	Washington T.	12*c*	D. M.	Portland	1, 033. 5
North Base at Dalles	Oregon	20*a*	5	....do	187. 5
Astronomical Station at Dalles	....do	20*a*	5	....do	134. 7
South Base	....do	20*a*	5	... do	215. 4
Dalles Hill	... do	20*a*	6	....do	1, 210. 1
Shivar's Bridge, Deschutes River	....do	20*a*	4	....do	702. 0
Finnegan's Ranch, Military Road	....do	20*a*	2	....do	2, 143. 7
Cross Hollows	....do	20*a*	4	....do	3, 197. 3
Divide on Shivar's Road, between John Day and Deschutes Rivers.	... do	20*a*	1	....do	3, 515. 0
Divide on O-cho-co and Cross Hollow, between John Day and Deschutes Rivers.	....do	20*a*	1	....do	3, 354. 5
Divide, Head Antelope Valley, between John Day and Deschutes Rivers.	....do	20*a*	1	....do	3, 298. 2
Antelope Post Office	....do	20*a*	2	....do	2, 844. 5
Divide, Cañon City Road, between John Day and Deschutes Rivers.	....do	20*a*	1	....do	3, 694. 7

List of Altitudes—Continued.

Number.	Locality.	State or Territory.	Atlas-sheet.	Number of observations.	Reference station.	Altitude above sea-level.
						Feet.
14	Camas Prairie	Oregon	20*a*	2	Portland	3,019
15	Big Prairie	...do	20*a*	4	...do	3,334
16	Summit Prairie	...do	20*a*	4	...do	3,694
17	Upper Cascade	...do	20*a*	6	...do	126
18	Deschutes Bridge	...do	20*a*	2	...do	165
19	Grant's Landing	...do	20*a*	4	...do	336
20	Barnum's Ranch	...do	20*a*	2	...do	1,795
21	Mutton Mountain	...do	20*a*	2	...do	3,692
22	The Dalles	...do	20*a*	D. M.	...do	179
23	Currant Creek Stage Station	...do	20*b*	4	...do	2,142
24	Burnt Ranch, John Day River	...do	20*b*	2	...do	1,561
25	Carmical's Ranch	...do	20*c*	D. M. and 4	Portland and Red Bluff.	2,736
26	Warm Spring Indian Agency	...do	20*c*	....	Portland	1,51
27	Warm Springs	...do	20*c*	1	...do	1,52
28	Klikatat Hill	...do	20*c*	4	...do	3,06
29	Deschutes River Bridge	...do	20*c*	2	...do	2,56
30	Parrish Ranch	...do	20*c*	2	...do	3,33
31	Fish Lake	...do	20*c*	2	...do	3,15
32	Prineville	...do	20*c*	4	Red Bluff	2,89
33	Green's Ranch	...do	20*c*	6	Winnemucca	4,47
34	Lodge Pole Spring	...do	20*c*	2	Portland	1,64
35	Mud Springs	...do	20*c*	2	Red Bluff	2,44
36	Hald's Ranch	...do	20*d*	2	Portland	3,28
37	Big Summit Prairie	...do	20*d*	2	Winnemucca	5,12
38	North Twin Lake	...do	28*d*	1	Red Bluff	5,11
39	Mount Pitt	...do	28*d*	4	...do	9,81
40	Union Peak	...do	28*d*	3	...do	7,29
41	Mount Scott	...do	28*d*	6	...do	9,01
42	Summit of road to Crater Lake	...do	28*d*	2	...do	6,41
43	Crater Lake	...do	28*d*	5	...do	7,14
44	Corral Springs	...do	28*b*	2	...do	4,56
45	Edge of Summit Lake	...do	28*b*	1	...do	5,61
46	Diamond Peak	...do	28*b*	2	...do	8,806.
47	North end of Davis Lake	...do	28*b*	2	...do	4,466.
48	Farewell Bend, Deschutes River	...do	29*a*	2	Portland and Red Bluff.	3,620.9
49	Langden's Ranch	...do	29*a*	2	Winnemucca	5,162.9
50	Button's Ranch	...do	29*a*	2	...do	4,236.7
51	"Halfway," on East Deschutes River	...do	29*a*	4	Red Bluff	4,081.1
52	Fall Creek Cascade	...do	29*a*	2	Camp 8	4,177.8
53	Little Prairie	...do	29*a*	2	...do	4,428.0
54	Big Meadows	...do	29*a*	D. M.	Red Bluff	4,123.7
55	Dillard & Renshaw's Ranch	...do	29*b*	2	Winnemucca	4,656.6
56	Curry Spring	...do	29*b*	2	...do	4,272.9
57	Hoskin's Ranch, Silver Creek	...do	29*b*	2	...do	4,139.1
58	Head of Chewaucan Marsh	...do	29*c*	2	...do	4,336.0
59	Bratton's Ranch	...do	29*c*	D. M.	...do	4,495.4
60	Timber Mountain	...do	29*c*	4	Camp 7	7,518.8
61	Summer Lake (water's edge)	...do	29*c*	1	Winnemucca	4,163.2
62	Foster's Ranch, on Summer Lake	...do	29*c*	2	...do	4,174.3
63	South end Sikan Marsh	...do	29*c*	5	...do	4,939.9
64	Klamath Reservation	...do	29*c*	2	...do	4,943.9
65	Fort Klamath	...do	29*c*	....	...do	4,108.4
66	Klamath Marsh	...do	29*c*	1	Red Bluff	4,371.1
67	Durand's Ranch	...do	29*c*	2	Winnemucca	4,312.0
68	Parton's Ranch	...do	29*c*	2	...do	4,497.6
69	Miller's Ranch	...do	29*c*	2	...do	4,420.3
70	Big Springs	...do	29*c*	2	Red Bluff	4,552.5
71	Corral Spring	...do	29*c*	D. M.	...do	4,782.6
72	Pauline Peak	...do	29*c*	1	...do	7,357.2
73	Camp Warner	...do	29*d*	2 and 3	Winnemucca	5,730.3
74	Alkaline Desert	...do	29*d*	1	...do	4,259.8
75	North end of Albert Alkaline Lake	...do	29*d*	2	...do	4,266.7
76	Mule Spring	...do	29*d*	2	...do	4,736.5
77	Warner Lake Flat	...do	29*d*	2	...do	4,542.6
78	Jones' Ranch, Honey Creek	...do	29*d*	D. M., and 2.	...do	4,466.6
79	Moss's Ranch	...do	29*d*	2	...do	4,887.8
80	Mesa Summit, west of Warner Valley	...do	29*d*	1	...do	4,894.0
81	Drew Valley post-office	Oregon	38*a*	1	Camp 40	4,952.6
82	Lo-lo-che-wis Peak	...do	38*a*	3	Winnemucca	7,957.2
83	Sugar Loaf Mountain	California	38*b*	....	Winnemucca and camp 45.	8,415.6

List of Altitudes—Continued.

Locality.	State or Territory.	Atlas-sheet.	Number of observations.	Reference station.	Altitude above sea-level.
					Feet.
Ranch, Warner Lake	California	38*b*	2	Winnemucca	4,486.8
ell	do	38*b*			4,647.0
Lake Spring	do	38*b*	2	Winnemucca	5,329.4
Lake	do	38*b*	2	do	6,041.2
	do	38*b*		do	4,851.0
Pass, summit of	Oregon	38*b*	1	do	6,355.6
Surprise Valley	do	38*b*	1 and 3	do	4,674.5
Valley	do	38*b*	3	do	8,308.1
Ranch Valley	do	38*b*	2	do	4,819.4
, west edge Valley	do	38*b*	1	do	4,697.0
Peak	do	38*b*	3	Winnemucca and camp 47.	8,471.6
Peak	California	38*b*	3	Camp 48	7,848.5
Pass	do	38*b*	1	Winnemucca	7,034.5
	do	38*b*	1	do	4,623.5
well	do	38*b*	3	Camp Bidwell	8,551.2
e" Cañon Pass	Nevada	38*b*	1	Winnemucca	6,305.8
s Peak	California	38*d*	7	Winnemucca and camp 15.	7,995.2
nch	do	38*d*	3	Winnemucca	5,040.4
g	do	38*d*	3	do	5,476.5
n Peak	do	38*d*	3	do	8,009.3
nch, Madeline Plains	do	38*d*	1	do	5,338.6
Valley	do	38*d*	D. M.	do	5,375.7
Peak	do	38*d*	3	Camp 23	7,954.0
s Ranch	do	38*d*	1	do	5,297.0
lat Peak	do	38*d*	2	Camp 27	7,676.1
	do	38*d*	3	Winnemucca	5,594.7
	do	38*d*	2	do	5,807.9
eak	do	38*d*	3	Camp 33	9,668.0
	do	38*d*	5	Winnemucca	4,364.9
	do	38*d*	2	do	4,632.5
e, Surprise Valley	do	38*d*	1	do	4,551.4
outh High Rock Cañon	Nevada	38*d*	1	do	4,966.8
ak	do	38*d*	3	do	8,584.7
ring	do	38*d*	5	do	5,905.8
ottonwood Cañon	do	38*d*	8	do	6,065.7
ite Peak	do	38*d*	3	do	8,363.1
g	do	38*d*	5	do	5,638.8
Hill	do	38*d*	3	Camp 63	6,734.3
's Camp, Long Valley	do	33*d*	1	Winnemucca	5,779.2
's Ranch	do	38*d*	1	do	5,850.9
ch, Surprise Valley	California	38*d*	2	do	4,679.6
nch	Nevada	38*d*	2	do	4,676.8
ak	do	38*d*	3	Camp 70 and Sacramento.	8,990.1
g	do	38*d*	2	Winnemucca	3,912.2
ows	do	39*c*	5	do	4,318.0
ak	do	39*c*	3	do	8,618.2
nch	California	46*b*	D. M.	Red Bluff	360.0
nch	do	46*b*	D. M.	do	280.7
ion	do	46*b*	D. M.	do	259.7
Mill	do	47*a*	2	do	3,420.2
ew Settlement	do	47*a*	3	do	4,991.9
ch	do	47*a*	D. M. and 3	do	5,157.0
Valley, ½ mile north of Quincy	do	47*a*	D. M.	do	3,374.4
ar Kingsbury's Mining Claim	do	47*a*	2	do	2,678.4
idge, North Fork	do	47*a*	1	do	2,843.4
nch	do	47*a*	2	do	4,055.1
k House	do	47*a*	D. M.	do	5,758.1
ings	do	47*a*	1	do	6,309.6
ip Creek	do	47*a*	D. M.	do	5,953.7
l Gate	do	47*a*	4	do	4,808.3
ch	do	47*a*	2	do	2,217.4
	do	47*a*	3	do	3,847.8
nch	do	47*a*	D. M.	do	4,989.7
	do	47*a*	4	do	5,426.6
Meadows	do	47*a*	D. M.	do	4,518.1
tain	do	47*a*	4	do	7,830.6
	do	47*a*		do	4,394.1
	do	47*a*	1	do	5,864.0
	do	47*a*	1	do	5,907.8
s	do	47*a*	1	do	6,080.2

List of Altitudes—Continued.

Number.	Locality.	State or Territory.	Atlas-sheet.	Number of observations.	Reference st tion.
154	Martin's Ranch	California	47*a*	2	Red Bluff.
155	Nash's Ranch	do	47*a*	D. M.	do
156	Mount Dyer, near Big Meadows	do	47*a*	4	do
157	Willow Lake	do	47*a*	2	do
158	Lassen's Butte	do	47*a*	....	Prattville an Red Bluff.
159	Mount Harkness, near Big Meadows	do	47*a*	1	do
160	Dutch Hill Mining Camp	do	47*a*	1	do
161	Grizzly Hill	do	47*a*	1	do
162	Greenville	do	47*a*	1	do
163	Forgay's Ranch	do	47*a*	4	do
164	Jim Ford's Ranch	do	47*a*	2	do
165	Johnson's Ranch	do	47*a*	4	do
166	Peter Lassen's Grave, Henry Lake Valley	do	47*a*	1	do
167	Stockton Mill	do	47*a*	3	do
168	Goodrich's Ranch	do	47*a*	6 and 2	do
169	Mitchell's Ranch	do	47*a*	2	do
170	Peach Spring	do	47*a*	D. M.	do
171	Upper edge of crater—cinder cone	do	47*a*	1	do
172	Bottom of crater	do	47*a*	1	do
173	Foot of slope of cone	do	47*a*	1	do
174	Second lake east of cone	do	47*a*	1	do
175	Divide, Noble Pass	do	47*a*	1	do
176	Loomis's Ranch	do	47*a*	D. M.	do
177	Quincy	do	47*a*	....	do
178	Ogburn's Ranch	do	47*a*	D. M.	Red Bluff
179	Wilson's Ranch	do	47*a*	2	do
180	Hickman's Ranch	do	47*a*	5	do
181	Toll Gate, Battle Creek Road	do	47*a*	7	do
182	Gray's Ranch	do	47*a*	2	do
183	Hart's Ranch	do	47*a*	2	do
184	Phillips' Ranch	do	47*a*	D. M.	do
185	Claremont Hill south of Quincy	do	47*a*	4	do
186	Old Toll House, between Quincy and Taylorsville.	do	47*a*	3	do
187	Hough's Mountain	do	47*a*	1	do
188	Taylorsville	do	47*a*	1	do
189	Kettle Rock Peak	do	47*a*	2	do
190	Parker's Ranch	do	47*a*	2	do
191	Divide between Kingsbury's Ranch and Caribou Bridge.	do	47*a*	1	do
192	Main divide between Miller's and Longville (on road.)	do	47*a*	1	do
193	Longville	do	47*a*	....	do
194	Main divide between Longville and Butte Creek House.	do	47*a*	1	do
195	Divide between Colby's and Toll Gate	do	47*a*	....	do
196	Bridge over Butte Creek (7½ miles from Prattville.)	do	47*a*	1	do
197	Moonlight Valley	do	47*a*	....	do
198	Taylorville to Susanville, main divide	do	47*a*	....	do
199	Susanville Post-office	do	47*a*	7	American F
200	First divide, between Susanville and Eagle Lake.	do	47*a*	1	Winnemucca
201	Second divide, between Susanville and Eagle Lake.	do	47*a*	1	do
202	Main divide, between Susanville and Eagle Lake.	do	47*a*	1	do
203	Eagle Lake	do	47*a*	D.M.&2	do
204	Willow Spring (head Willow Creek)	do	47*a*	1	do
205	Honey Lake	do	47*b*	1	Carson City.
206	Adam's Peak	do	47*b*	8	Camp 6
207	Mape's Ranch	do	47*b*	3	Carson City.
208	Crow's Ranch, Clover Valley	do	47*b*	D. M.	do
209	Keg Spring, Willow Creek	do	47*b*	2	Crow's Ranc
210	McKesick's Peak	do	47*b*	3	do
211	Omjumi Peak	do	47*b*	8	Crow's Ranc and Carso City.
212	Frenchman's Cove	do	47*b*	4	Crow's Ranc
213	Mount Ingalls	do	47*b*	9	Crow's Ranc and Carso City.
214	Mount Wellington	do	47*b*	5	Crow's Ranc

List of Altitudes—Continued.

Locality.	State or Territory.	Atlas-sheet.	Number of observations.	Reference station.	Altitude above sea-level.
					Feet.
t Chance and Sqnaw Queen Creeks, nction of.	California	*47b*	2	Carson City	5, 268. 2
t Chance and Thompson Creeks, nction of.	do	*47b*	2	do	5, 431. 1
e Line Peak	do	*47b*	5	do	8, 405. 2
rphy's Ranch, Buffalo Salt Works	do	*47b*	1	Winnemucca	3, 845. 0
ep Head	do	*47b*	2	do	3, 913. 6
on's Ranch	do	*47b*	2	do	4, 076. 4
mway's Ranch	do	*47b*	8	do	5, 067. 0
Kesick's Ranch	do	*47b*	1	do	4, 469. 2
ke Creek Depot	do	*47b*	2	do	4, 163. 7
nemucca Lake	Nevada	*47b*	2	American Flat	3, 824. 6
ha-kum Peak	do	*47b*	3	do	8, 174. 0
od's Ranch, Pyramid Lake	do	*47b*	1	do	3, 861. 3
ning's Ranch	do	*47b*	2 and 2	do	4, 571. 0
low Ranch	California	*47b*	1 and 11	American Flat and Carson City.	4, 275. 3
mpson's Peak	do	*47b*	6, 12, 12	Camp 7, American Flat.	7, 752. 2
th End Pyramid Lake	Nevada	*47b*	1	American Flat	3, 847. 9
no's Ranch	do	*47b*	3 and 2	do	4, 187. 3
vton's Ranch, near Honey Lake	do	*47b*	2	do	4, 078. 6
Springs Peak	do	*47b*	3	Winnemucca	7, 692. 1
affer's Station	do	*47b*	3 and 2	do	4, 026. 1
affer's Peak	do	*47b*	4	do	6, 864. 5
co	California	*47c*	D. M.	Red Bluff	174. 9
treville	do	*47c*	2	do	502. 5
ervoir in Concord Valley	do	*47c*	1	do	2, 021. 9
d Spring Ranch	do	*47c*	2	do	564. 5
well's Bar, south fork Feather River	do	*47c*	3	do	342. 1
ction House	do	*47c*	2	do	3, 562. 2
nshew	do	*47c*	3	do	2, 451. 3
mbug Park	do	*47d*	2	do	4, 846. 6
lor's Ranch	Nevada	*47d*	1	Winnemucca	4, 719. 5
lerson's Ranch, Fish Spring	do	*47d*	2	do	4, 041. 1
pman's Ranch	do	*47d*	2	do	4, 931. 6
llar Potosi Mining Company's office	do	*47d*	D. M.	Salt Lake City	6, 242. 3
ickerbocker Mine	do	*47d*	1	Chollar Potosi	5, 867. 2
timore Mine	do	*47d*	1	do	5, 729. 3
be Consolidated	do	*47d*	1	do	5, 781. 0
d Hill Mine	do	*47d*	1	do	6, 373. 6
erior G. & S. Mine	do	*47d*	1	do	6, 415. 3
st Belcher Mine	do	*47d*	1	do	6, 098. 4
jan Mine	do	*47d*	1	do	6, 085. 7
per Caledonia Mine	do	*47d*	1	do	5, 986. 9
opa Mine	do	*47d*	1	do	5, 978. 3
t Justice Hill	do	*47d*	3	do	5, 861. 2
on Mill Point	do	*47d*	2	do	5, 327. 2
nsell Mill, near Silver City	do	*47d*	1	do	5, 324. 3
il's Gate Toll House, Silver City	do	*47d*	1	do	5, 148. 1
Foundery, Silver City	do	*47d*	1	do	4, 940. 3
Mina Post, near Succor Mine	do	*47d*	1	do	5, 451. 8
ian Mine	do	*47d*	1	do	5, 414. 6
by Mine	do	*47d*	1	do	4, 885. 5
np Rock	do	*47d*	3	do	5, 628. 2
erican Flat Peak	do	*47d*	2	do	6, 659. 0
lroad Peak (Black Rock)	do	*47d*	1	do	5, 436. 0
t McClellan Peak	do	*47d*	2	do	6, 180. 8
k Island Mine	do	*47d*	2	do	5, 677. 5
es's Milk Ranch	do	*47d*	2	do	5, 736. 1
e Consolidated Mine	do	*47d*	1	do	5, 268. 2
lliam Penn Mine	do	*47d*	1	do	5, 235. 6
keye Mine	do	*47d*	1	do	5, 220. 8
son's Station	do	*47d*	2	American Flat	4, 245. 0
ctor's Ranch, Truckee River	do	*47d*	2	do	3, 963. 4
amid Lake Indian Agency	do	*47d*	2	do	3, 980. 0
ers's Ranch, near Reno	do	*47d*	3	do	4, 438. 6
nters' Ranch	do	*47d*	4	do	5, 145. 2
dsworth, Central Pacific Railroad	do	*47d*			4, 094. 8
ne Station	do	*48d*	1	Winnemucca	4, 815. 7
mile north of Butte Mountain	do	*48b*	3	do	4, 555. 2
metheus Peak	do	*48d*	6	do	8, 140. 7
ker's Ranch	do	*48d*	3	do	7, 147. 9

List of Altitudes—Continued.

Number.	Locality.	State or Territory.	Atlas-sheet.	Number of observations.	Reference tion.
284	Geneva Peak	Nevada	48*d*	2	Winnemu
285	Mouth Underdown Cañon, Reese River	do	48*d*	2 and 5	do
286	Birchim's Peak	do	48*d*	3	do
287	Welche's Ranch	do	48*d*	3	do
288	Emigrant Peak	do	48*d*	1	do
289	Monument at south end of Austin base line.	do	48*d*	1	do
290	Monument at north end of Austin base line.	do	48*d*	1	do
291	Wallace's Ranch	do	48*d*	2	do
292	Rooker's Corral	do	48*d*	4	do
293	Vaughan's Ranch	do	48*d*	1	do
294	Highland Peak	California	56*b*		
295	Lillie's Ranch	do	56*b*	2	Sacrament
296	West Point	do	56*b*	2	do
297	Antelope Spring	do	56*b*	2	do
298	Two miles west of Tragedy Springs	do	56*b*	2	do
299	Halfway House	do	56*b*	4	do
300	Shaw's Ranch	do	56*b*	2	do
301	Castle Rock	do	56*b*	6	Sacrament Winnem
302	Cooper's Ranch	do	56*b*	4	Sacrament
303	Grizzly Peak	do	56*b*	2	Sacrament Winnem
304	Warm Springs, Sonora Road	do	56*b*	2	Winnemuc
305	Lake near summit of Virginia Creek Trail	do	56*b*	2	Sacrament
306	Grass Lake	do	56*b*	1	do
307	Summit of Big Tree Road	do	56*b*	1	do
308	Big Meadow Ranch	do	56*b*	1	do
309	Fulsom & Hall's Ranch	do	56*b*	1	do
310	Suspension Bridge, Mokelumne River	do	56*b*	1	do
311	Wiley's Station, Amador Road	do	56*b*	1	do
312	Ham's Station, Amador Road	do	56*b*	4	do
313	Mud Spring, Amador Road	do	56*b*	1	do
314	Peddlers' Ranch, Amador Road	do	56*b*	1	do
315	Horsley's Camp	do	56*b*	1	do
316	Myers's Station	do	56*b*	1	do
317	Foster's Station	do	56*b*	1	do
318	Denser's Station	do	56*b*	1	do
319	Volcano	do	56*b*	1	do
320	Foster's Ranch	do	56*b*	1	do
321	Bridge over Middle Fork Mokelumne	do	56*b*	1	do
322	Railroad Flat	do	56*b*	1	do
323	Cabin in South Grove, Calaveras Big Trees	do	56*b*	1	do
324	Columbia P. O	do	56*b*	1	do
325	Bald Mountain	do	56*b*	2	do
326	Lily Creek, Sonora Road	do	56*b*	1	do
327	Mill Creek, Sonora Road	do	56*b*	1	do
328	Niagara Creek, Sonora Road	do	56*b*	1	do
329	Cow Creek Ranch, Sonora Road	do	56*b*	1	do
330	Head of flat, South Fork Herring Creek	do	56*b*	1	do
331	Burst Rock	do	56*b*	1	do
332	Lower Reservoir, ½ mile east of Strawberry.	do	56*b*	1	do
333	Junction of Herring Creek and Stanislaus River.	do	56*b*	1	do
334	Head of Stanislaus	do	56*b*	1	do
335	Small Lake on Relief Trail	do	56*b*	1	Winnemuc
336	Large Lake on Relief Trail	do	56*b*	1	do
337	Round Lake on Relief Trail	do	56*b*	1	do
338	Moran's Ranch	do	56*b*	1	Sacrament
339	Copperopolis, Dutch Henry's Ranch	do	56*c*	2	do
340	Gold Spring Ranch	do	56*d*	2	do
341	Northrups	do	56*d*	2	do
342	Strawberry	do	56*d*	3 and 2	do
343	Dunderberg Peak	do	56*d*	8	do
344	Summit of Virginia Creek Trail	do	56*d*	1	do
345	Lake near Summit Virginia Creek Trail	do	56*d*	2	do
346	Mouth of Lyell Creek	do	56*d*	2	do
347	Lambert's Soda Spring	do	56*d*	1	do
348	Snow's Hotel	do	56*d*	2	do
349	Top of Yosemite Fall	do	56*d*	4	Sacramen and Camp
350	Top of Vernal Fall	do	56*d*	4	do

List of Altitudes—Continued.

Number.	Locality.	State or Territory.	Atlas-sheet.	Number of observations.	Reference station.	Altitude above sea-level. *Feet.*
351	Foot of Vernal Fall	California	*56d*	4	Sacramento and Camp 38.	4,632.9
352	Upper Fall, Yosemite Falls	do	*56d*	4	do	4,965.1
353	Foot of Lower Fall, Yosemite Falls	do	*56d*	4	do	3,985.8
354	Top of Nevada Fall, Yosemite Valley	do	*56d*	4	do	5,808.0
355	Foot of Nevada Fall, Yosemite Valley	do	*56d*	4	do	5,203.4
356	Tamarack Flat	do	*56d*	2	Sacramento	6,233.9
357	Crane Flat	do	*56d*	....	do	6,053.6
358	Hodgdon's Meadows	do	*56d*	2 and 1	do	4,505.7
359	Wade's Meadows	do	*56d*	D. M. and 2.	do	4,567.0
360	Big Tree Tunnel, Oak Flat Road	do	*56d*	1	do	5,793.1
361	Hazel Green	do	*56d*	2	do	5,549.5
362	Big Meadows	do	*56d*	7	do	4,233.6
363	Eleven-mile Station Mariposa Road	do	*56d*	2	do	5,567.2
364	Big Tree Station	do	*56d*	3	do	3,925.3
365	Porcupine Flat	do	*56d*	2	do	7,748.5
366	Cold Spring	do	*56d*	D. M. and 2.	do	3,125.8
367	Murphy's Cabin, Lake Tenaiya	do	*56d*	....	Sacramento and Camp 41.	7,970.8
368	Head of Cascade Creek	do	*56d*	3	Camp 44	7,717.7
369	Pool at foot of Bridal Veil Fall	do	*56d*	5	Camp 48	4,031.9
370	Foot of Virgin's Tears Cliff	do	*56d*	3	Sacramento	5,310.7
371	Lower Bridge, Yosemite Valley	do	*56d*	3	do	3,843.1
372	Grizzly Giant, Mariposa Grove	do	*56d*	1	do	5,837.8
373	Summit Head of North Fork, San Joaquin	do	*56d*	2	do	7,253.3
374	Upper Chiquito Meadows	do	*56d*	2	do	6,763.2
375	Head of North Fork, San Joaquin	do	*56d*	2	do	7,184.5
376	Bridge North Fork, San Joaquin	do	*56d*	1	do	4,385.6
377	Mills of Madera Flume and Trading Co	do	*56d*	3	do	4,499.3
378	Mariposa	do	*56d*	4 and 3	do	1,961.8
379	Schultz Mountain	do	*50d*	11	do	2,275.2
380	Coulterville	do	*56d*	1	do	1,664.9
381	Peña Blanca (Haigh's Ranch)	do	*50d*	3	do	1,806.8
382	Moccasin Peak	do	*56d*	3	do	3,003.4
383	Culbertson's Vineyard	do	*50d*	2	do	980.5
384	Sonora (McQuaid's Ranch)	do	*56d*	2	do	1,888.5
385	Murphy's	do	*56d*	1	do	2,194.7
386	Vallecito Post-Office	do	*56d*	1	do	1,748.4
387	Parrott's Ferry	do	*56d*	1	do	834.4
388	Brown's Flat	do	*56d*	1	do	1,963.9
389	Sonora Post-Office	do	*56d*	1	do	1,815.7
390	Baxter's Station, Sonora Road	do	*56d*	1	do	4,114.5
391	Bridgeport	....	....	....	....	6,423.5
392	Swann's Ranch, East Walker River	California	*57a*	2	Winnemucca	5,041.7
393	Cory's Peak	do	*57a*	5	do	11,326.0
394	Aurora	do	*57a*	2	do	7,449.2
395	French's Peak	Nevada	*57b*	1	do	10,892.7
396	Deveringham's Ranch	do	*57b*	1	do	6,496.7
397	Poston Peak	do	*57b*	4	do	11,977.7
398	Adobe Meadows	California	*57c*	2	do	6,594.4
399	McBride's Ranch	do	*57c*	2	do	5,560.6
400	McBride's Peak	do	*57c*	6	do	13,442.7
401	Fort Lyon	Colorado	*62d*	....	....	3,910.2
402	Sizer's Ranch	do	*62d*	....	....	4,035.5
403	Anderson's Ranch	do	*62d*	3	Santa Fé	4,248.5
404	Lockwood's Ranch	do	*62d*	2 and 3	do	4,997.3
405	Hog Back	do	*62d*	3	do	5,466.8
406	Costilla	do	*62d*	2	do	7,792.5
407	Alkaline Station	do	*62d*	3	Denver	4,135.8
408	Vogle's Ranch	do	*62d*	4	Santa Fé	4,205.3
409	Head of Plum Cañon	do	*62d*	2	do	5,754.5
410	Lower end of Crane Valley	California	*64b*	2	Sacramento	3,184.8
411	Fresno Flat	do	*64b*	D. M.	do	2,192.4
412	Deadwood Peak	do	*64b*	8	do	4,451.3
413	Lewis Ranch	do	*64b*	2	do	966.0
414	Probasco's Ranch	do	*64b*	D. M.	do	972.5
415	Green Mountain	do	*64b*	10	do	1,351.7
416	Fresno, Cal	do	*64b*	D. M.	do	313.7
417	Fowler's Peak	do	*64b*	9	do	1,760.3
418	Cole's Ranch	do	*64b*	8 and 1	do	1,221.2
419	Base of Hazelton Peak	do	*64b*	6	do	478.6
420	Hazelton Peak	do	*64b*	3	do	2,960.5

List of Altitudes—Continued.

Number.	Locality.	State or Territory.	Atlas-sheet.	Number of observations.	Reference station.
421	Burrows Mountain	California	64*b*	11	Sacramento
422	Behring's Store	do	64*b*	3	do
423	Morrow Mountain	do	64*b*	7	do
424	Eisen Vineyard	do	64*b*	D. M.	do
425	Mark Mood Meadows	do	65*a*	5	do
426	Bald Rock	do	65*a*	8	do
427	Lookout Mountain	do	65*a*	3	Camp 21
428	Dusy's Ranch, on Dinky Creek	do	65*a*	3	Sacramento
429	Ash Springs	do	65*a*	2	do
430	Hyde's Union Saw-Mill	do	65*a*	2	do
431	Bald Mountain (*a*)	do	65*a*	6	do
432	Bald Mountain (*b*)	do	65*a*	3	do
433	Boyd's Ranch	do	65*a*	4	do
434	Stokes Mountain	do	65*a*	3	do
435	Scodie's Ranch	do	65*c*	5	Los Angeles
436	Canebrake Ranch	do	65*c*	3	do
437	Tilly's Ranch	do	65*c*	2	do
438	Trinchera	do	69*b*	2	Santa Fé
439	Myers' Ferry		69*b*	3	do
440	Cattle Ranch, Rio Grande		69*b*	2	do
441	San Cristobal Crossing	New Mexico	69*b*	2	do
442	San Cristobal Crossing, high bank	do			do
443	Taos	do	69*d*		
444	Ranchos de Taos	do	69*d*	1	Santa Fé
445	United States Mountain Pass No. 1	do	69*d*	1	do
446	United States Mountain Pass No. 2	do	69*d*	1	do
447	Head of drain of Pueblo Creek	do	69*d*	2	do
448	Pueblo de Picuris	do	69*d*	1	do
449	Embuda	do	69*d*	1	do
450	La Joya	do	69*d*		
451	Plaza del Alcalde	do	69*d*		
452	Pojoaque	do	69*d*		
453	Pueblo de San Juan	do	69*d*	1	Santa Fé
454	Cuyamungue	do	69*d*	1	do
455	Jesuque Creek, crossing S. F. and T. Road	do	69*d*		
456	Costilla Pass	do	70*a*	1	Santa Fé
457	Burbank's Ranch	do	70*a*	2	do
458	Purgatoire Road, 7 miles east of Trinidad	Colorado	70*a*	3	do
459	Purgatoire Road, 4½ miles west of Trinidad	do	70*a*	3	do
460	Cameron's Corner	New Mexico	70*a*	3	do
461	Ponil Pass	do	70*a*	1	do
462	Taos Pass	do	70*a*	1	do
463	Taylor's Ranch	do	70*a*	1	do
464	Fort Union	do	70*c*		
465	Dodge's Cut-off	do	70*c*	2	Santa Fé
466	Los Alamos	do	70*c*	2	do
467	Stone Ranch, Canadian Road	do	70*c*	2	do
468	Lake east of Mora	do	70*c*	2	do
469	Caliente	California	73*a*		Los Angeles
470	Pampa	do	73*a*	1 and 2	do
471	Havilah Town	do	73*a*	1	do
472	Palmer's Ranch	do	73*a*	2	do
473	Walker's Pass, summit of	do	73*a*	1	do
474	Birds' Springs	do	73*a*	3	do
475	Welden	do	73*a*	2	do
476	Dahlonega Hot Springs	do	73*a*	1	do
477	Granite Station	do	73*a*	2	do
478	Barker's Ranch	do	73*a*	2	do
479	Bakersfield	do	73*a*	2	do
480	Soap Spring	do	73*a*	2	do
481	Tejon Ranch	do	73*a*	3	do
482	David McKenzie's Ranch	do	73*a*	1	do
483	Twin Lake	do	73*a*	2	do
484	Breckinridge Mountain	do	73*a*	3	do
485	Lievre Ranch	do	73*c*	2	do
486	Hughes Ranch	do	73*c*	3	do
487	Junction of Lievre and Castac Creeks	do	73*c*	1	do
488	Newhall's Ranch	do	73*c*	2	do
489	San Fernando Tunnel, south mouth	do	73*c*	1	do
490	San Fernando Mission	do	73*c*		do
491	Brown's Ranch	do	73*c*	2	do
492	Divide on old stage road between San Fernando Plains and Simi Valley.	do	73*c*	1	do

List of Altitudes—Continued.

Locality.	State or Territory.	Atlas-sheet.	Number of observations.	Reference station.	Altitude above sea-level.
					Feet.
o Ranch	California	73*c*	2	Los Angeles	1,373.0
i Ranch	do	73*c*	1	do	678.6
Pozos Ranch	do	73*c*	2	do	258.6
ingville	do	73*c*	2	do	48.4
ejo Ranch	do	73*c*	4	do	579.8
ta Rosa Valley	do	73*c*	1	do	174.7
wberry Park, Camp 39	do	73*c*	3	do	830.1
aro	do	73*c*	5	do	1,027.9
n's Head	do	73*c*	6	do	1,693.4
Encinos Ranch	do	73*c*	7 and 5	do	772.0
uenga Pass	do	73*c*	1	do	750.0
ta Monica	do	73*c*	4	do	15.4
kershin's Ranch	do	73*c*	2	do	568.3
amore Grove	do	73*c*	1	do	447.2
eral Stoneman's House	do	73*c*	1	do	645.1
Gabriel Peak	do	73*c*			6,232.0
sa	do	73*c*	2	Los Angeles	598.7
ton's Ranch	do	73*c*	1	do	568.2
Gabriel Mine	do	73*d*	2	do	1,702.5
to Rock	do	73*d*	2	do	3,903.4
Narrows	do	73*d*	2	do	2,507.0
amonga Ranch	do	73*d*	2	do	1,168.0
Bernardino	do	73*d*	2	do	950.1
kton's Cabin	do	73*d*	7	do	5,876.9
tthew's Ranch	do	73*d*	4	do	6,294.4
on Cañon (Fear's Station)	do	73*d*	2	do	3,162.2
Cabin	do	73*d*	4	do	5,329.1
r Valley Town Hotel	do	73*d*	2 and 2	do	6,592.0
see's Ranch	do	73*d*	4	do	3,587.1
nery	do	73*d*	2	do	4,399.9
-mill in Little Bear Valley	do	73*d*	1	do	4,884.7
isky Johnny's.	do	73*d*	2	do	5,185.9
terman's, R. W	do	73*d*	1	do	1,908.4
on	do	73*d*	2	do	808.2
Spring Encinoso	New Mexico	76*d*	5	Silver City	7,203.6
h Peak	do	76*d*	3	do	9,434.2
ta Mangos	do	76*d*	2	do	*7,318.8
Quemado	do	76*d*	4	do	6,826.7
Pilla	Arizona	76*d*	2	do	5,849.8
lligan's	do	76*d*	3	Fort Bayard	6,912.2
ote Spring	do	76*d*	2	do	6,874.3
Francisco on Rio Puerco	New Mexico	77*a*	3	Santa Fé	5,444.1
Bajada	do	77*b*			5,514.5
to Domingo	do	77*b*	1	Santa Fé	5,109.8
Pinos	do	77*b*	1	do	4,674.8
alta	do	77*b*	1	do	4,661.1
r Placers	do	77*b*	3	do	6,666.9
er Peak	do	77*b*	4	Camp 22	8,965.2
ernal Water Hole	do	77*b*	D. M. and 3	Santa Fé	7,140.1
ernal Peak	do	77*b*	6	Camp 28	7,580.3
ernal Pass	do	77*b*	1	Santa Fé	7,180.7
Marco's Spring	do	77*b*	2	do	6,055.8
th Sandia Peak	do	77*b*	7	do	8,567.4
an Ranch	do	77*b*	2	do	5,290.3
a Blanca	do	77*b*	D. M	do	5,170.2
Grande at Ford	do	77*b*	1	do	5,107.1
ta Aña	do	77*b*		do	5,292.0
ide, eastern rim Rio Puerco	do	77*b*	1	do	5,934.1
Louis Rey	do	77*b*	2	do	5,152.0
th of Rio Callo	do	77*b*	1	do	5,019.1
ras, ¼ mile above	do	77*b*	2	do	6,306.3
rro Ford	do	77*c*	1	do	4,533.8
rro	do	77*c*	2 and 3	do	4,619.3
blo Springs	do	77*c*	2	do	6,398.1
o de Culebra	do	77*c*	3	do	6,992.2
bra Spring	do	77*c*	4	do	5,706.6
rro Peak	do	77*c*	10	do	7,281.1
adero Peak	do	77*c*	5	do	7,324.9
le la Quinca	do	77*c*	2	do	5,673.4
ones Peak	do	77*c*	4	Camp 42	9,214.3
José	do	77*c*		Camp 45	*5,057.1
Grande Ford near Socorro	do	77*c*	1	Santa Fé	4,626.9

List of Altitudes—Continued.

Number.	Locality.	State or Territory.	Atlas-sheet.	Number of observations.	Reference st tion.
565	Casa Colorada	New Mexico	77*d*	1	Santa Fé
566	Ojo de la Parida	do	77*d*	2	do
567	Cerro Tecolote	do	77*d*	7	Camp 72
568	Gallinas Spring	do	77*d*	3 and 7	Santa Fé ar Fort Crai
569	West Gallinas Mountain	do	77*d*	10	Camp 73 ar Santa Fé.
570	Laguna Gallinas	do	77*d*	D. M.	Fort Craig
571	Gran Quivira	do	77*d*	D. M.	do
572	Punta de Agua	do	77*d*	1	do
573	Lomitas Spring	do	77*d*	3	do
574	Chupadero Spring	do	77*d*	3	do
575	Chupadero Ranch	do	77*d*	D. M.	do
576	Gallinas Ranch	do	77*d*	3	Santa Fé
577	Berendo Spring	do	77*d*	1	do
578	Posos del Pino	do	77*d*	2, 5, & 3	do
579	Los Lunas	do	77*d*	....	....
580	Ojo del Oso, Camp 26	do	77*d*	D. M.	Santa Fé
581	Mosca Peak	do	77*d*	16	Camp 26
582	Ojo de Estancia	do	77*d*	....	Santa Fé
583	Rattlesnake Hill	do	77*d*	5	Camp 30
584	La Laguna de Sal	do	77*d*	1	Santa Fé
585	Osha Peak	do	77*d*	5	Camp 33 ar Santa Fé.
586	Comanche Cañon Pass	do	77*d*	1	Santa Fé
587	Ojo de la Casa	do	77*d*	2	do
588	Belen	do	77*d*	....	....
589	Picacho de Sabinal	do	77*d*	....	....
590	Los Lunas Ford	do	77*d*	1	Santa Fé
591	Manzano Peak	do	77*d*	1	do
592	Tomasceños Water Holes	do	77*d*	1	do
593	Ojo del Cibolo	do	77*d*	2	do
594	Cibolo Hill	do	77*d*	1	do
595	Tanques de Cañoncito	do	77*d*	2	do
596	Constancia	do	77*d*	1	do
597	Ojo de las Cañas	do	77*d*	2	do
598	Mesteñito Ranch	do	77*d*	3	do
599	Pyramid Hill	do	77*d*	4	Camp 58 ar Santa Fé.
600	Upper Abo Pass	do	77*d*	1	Santa Fé
601	Ojo Chameleon	do	77*d*	4	Camp 10
602	Alamillo	do	77*d*	2	Santa Fé
603	Algodones	do	77*d*	D. M.	Georgetow and Santa
604	Sandia	do	77*d*	1	do
605	Alameda	do	77*d*	1	do
606	Mouth of Rincon Colorado	do	78*a*	3	Santa Fé
607	Head of Cañon Largo	do	78*a*	4	do
608	South end of Mesa Chupaines	do	78*a*	5	do
609	Head of Cañon de Agua	do	78*a*	1	do
610	Mouth of Conchas Cañon, west bank of Arroyo.	do	78*a*	3	do
611	Church at Riverside	California	80*b*	1	Los Angeles
612	Santa Aña Hotel	do	80*b*	2	do
613	Camp Apache	Arizona	83*b*	....	Santa Fé
614	Cienega Amarilla	New Mexico	83*b*	2	Fort Bayard Silver Cit
615	Carrizo Spring	do	83*b*	2	Fort Bayar
616	Gallo Spring	do	83*b*	2	do
617	Patterson's Ranch	do	83*b*	4 and 2	Fort Bayard Silver Cit
618	Paria's Spring	do	83*b*	2	Silver City
619	Becker's Store, Springerville	Arizona	83*b*	2	do
620	San Francisco	New Mexico	83*b*	2	do
621	Torreon Springs	do	84*a*	D. M.	Santa Fé
622	Cuchilla Negra	do	84*a*	1	do
623	Ferry to Fort McRae	do	84*a*	1	do
624	Fort McRae	do	84*a*	....	Silver City a Santa Fé,
625	Eight-tenths mile above Fort McRae	do	84*a*	3	Santa Fé
626	Alamocita	do	84*a*	1	do
627	Rio Grande, 2½ miles above Alamocita	do	84*a*	3	do
628	Chupadero Spring	do	84*a*	5	do

List of Altitudes—Continued.

Locality.	State or Territory.	Atlas-sheet.	Number of observations.	Reference station.	Altitude above sea-level.
					Feet.
ay Cristobal	New Mexico	84*a*	9	Camp 42	6,646.2
raje	do	84*a*	1	Santa Fé	4,319.2
raje Ferry	do	84*a*	D. M.	do	4,352.5
n Mateo Peak	do	84*a*	8	do	10,208.6
Monica Springs	do	84*a*		Silver City and Santa Fé.	7,601.9
gdelena Peak	do	84*a*	9	Camp 40	10,798.0
rcia Peak	do	84*a*	3	do	9,919.8
n Mateo Divide	do	84*a*	1	Silver City	8,960.1
Caliente	do	84*a*	4 and 2	do	6,081.0
aw's Ranch	do	84*a*	4	do	7,255.7
l Camp Sherman	do	84*a*	D. M.	do	6,926.6
amo Station	do	84*a*	3	do	6,593.0
mp Vincent	do	84*a*	6	do	6,188.1
Knight's Ranch	do	84*a*	2	do	6,237.2
ntinental Divide, head of Cuchillo Negro.	do	84*a*	1	do	7,698.2
ad of Middle Fork Cuchillo Negro	do	84*a*	2	do	7,628.3
era Spring	do	84*a*	D. M.	do	7,585.2
ntinental Divide, on road from Ojo Caliente to Shaw's Ranch.	do	84*a*	1	do	7,921.5
rt Craig	do	84*a*	D. M.	Santa Fé	4,447.5
ussaint's Ranch	do	84*b*	3	do	4,634.0
ipping Springs	do	84*b*	D. M.	Fort Craig	5,623.4
linas Peak	do	84*b*	9	Dripp'g Spring	9,039.5
und Spring	do	84*b*	4	Fort Craig	4,335.7
raloso Spring	do	84*b*		do	4,783.1
gal Peak	do	84*b*	5	Camp 50	9,983.0
rt Stanton	do	84*b*			6,151.5
wlin's Mill	do	84*b*			6,491.0
ad of Carrizo Creek	do	84*b*	2	Fort Craig	8,831.3
rra Blanca Peak	do	84*b*	9	Fort Craig and Santa Fé.	11,892.3
es Cerros Spring	do	84*b*	1	Fort Craig	6,127.7
st Carrizo Cone	do	84*b*	9	do	7,975.7
rphy's Ranch, Carrizozo Spring	do	84*b*			5,300.0
rth end of Mal-Pais	do	84*b*	6	Fort Craig	5,360.4
hite Oak Spring	do	84*b*	3	do	6,617.7
ylor's Ranch, Jicarilla Mountains	do	84*b*	6	do	6,988.3
inter's Ranch, Jicarilla Mountains	do	84*b*			6,582.4
est Jicarilla Cone	do	84*b*	5	Camp 71	7,726.7
mp Llano Spring	do	84*b*	4	Fort Craig	5,348.2
rro Colorado	do	84*b*	9	Camp 81	5,653.7
n Pedro	do	84*b*	1	Fort Craig	4,488.4
n Marcial	do	84*b*	1	do	4,385.1
cura Water Holes	do	84*b*	D. M.	do	5,461.3
uth Oscura Mountain	do	84*b*	7	Camp 93	8,732.3
al-Pais Spring	do	84*b*	4	Fort Craig	4,105.6
o Milagro	do	84*b*	3	do	5,172.5
ertocito	do	84*b*	5		6,428.3
miles above Mal-Pais Spring	do	84*b*	3	Fort Bliss	4,115.0
rt Selden	do	84*c*			3,900.0
int of Rocks	do	84*c*	D. M.	Silver City	4,268.3
eman or Martin's Ranch	do	84*c*	5	do	4,594.3
ft bank Rio Grande, opposite Polomas	do	84*c*	D. M.	do	4,120.8
o Grande, 39 miles from Polomas	do	84*c*	2	Fort Bayard	3,955.5
irbell Hill	do	84*c*	2	Silver City	6,588.9
llsboro'	do	84*c*		do	5,223.8
per Ford of Black River	do	84*c*	3	do	6,702.3
st Ranch	do	84*c*	D. M.	Fort Bliss	4,183.5
trance to Nell's Pass	do	84*c*	1	Silver City	6,683.3
lomas	do	84*c*	4	do	4,160.4
ent's Ranch	do	84*c*	1	do	4,021.4
aw's Ranch, Animas River	do	84*c*	4	do	4,691.9
imas Peak	do	84*c*	2	do	6,106.1
vide at head of Perces River	do	84*c*	1	Camp 48	8,264.2
ad of Sierra Blanca Creek	do	84*c*	4	Fort Bayard	6,307.1
vide at head of Chicken Creek	do	84*c*	1	do	7,445.1
Ever's Ranch	do	84*c*	2	do	5,086.2
lorado Plaza, Rio Grande	do	84*c*	2	do	4,007.8
acho Peak	do	84*c*	1	do	4,824.5
cum's Ranch	do	84*c*	2	do	4,519.1
gdalena Pass	do	84*c*	1	do	4,754.6

List of Altitudes—Continued.

Number.	Locality.	State or Territory.	Atlas-sheet.	Number of observations.	Reference s tion.
698	Mason's Ranch	New Mexico	84c	2	Fort Bayar
699	Cañada Ranch	do	84c	3	Silver City.
700	Fort Cummings	do	84c	....	....
701	Macho or Mule Springs	do	84c	....	....
702	Mule Springs, 5 miles west of Macho Springs.	do	84c	2	Silver City.
703	Hurricane Rock	do	84c	2	do
704	Rio Mimbres Ford	do	84c	1	do
705	Warm Springs	do	84c	....	Santa Fé a Silver Cit
706	Mimbres Settlement	do	84c	1	Silver City.
707	Crittenden's Ranch	do	84c	1	do
708	Divide, between Warm Springs and Mimbres Settlement.	do	84c	1	do
709	Hot Springs	do	84c	1	do
710	Fort Bayard	do	84c	....	....
711	Lone Mountain	do	84c	3	Silver City
712	Apache Tejo	do	84c	....	....
713	Cow Spring	do	84c	....	....
714	Hot Springs (13 miles from Magruder's)	do	84c	1	Santa Fé
715	Mimbre's Forks	do	84c	4	do
716	Head of Black River	do	84c	4	do
717	Diablo Knoll	do	84c	1	do
718	Pinos Altos	do	84c	8	do
719	Pinos Altos Peak	do	84c	3	do
720	Black Peak	do	84c	3	do
721	Hanover Peak	do	84c	3	do
722	Cook's Peak	do	84c	3	Silver City.
723	Santa Rita Copper Mines	do	84c	2	Santa Fé
724	Georgetown	do	84c	2	do
725	Hendrick's Peak	do	84c	3	do
726	South end of Bayard Base, Station B	do	84c	3	Silver City.
727	Cow Spring, Pyramid F	do	84c	3	do
728	Bluff Hill, Station D	do	84c	3	do
729	Tularosa	do	84d	3 D. M.	Silver City a Fort Crai
730	San Nicolas Spring	do	84d	3	Fort Bliss a Silver Cit
731	Shedd's Ranch, San Augustin	do	84d	D. M.	do
732	San Augustin Pass	do	84d	1	Fort Bliss
733	¼ mile south of White Water Spring	do	84d	3	Silver City.
734	Indian Agency, near Blazer's Mill	do	84d	3	....
735	Elk Spring	do	84d	D. M.	Santa Fé
736	Silver Springs	do	84d	D. M.	do
737	Head of Peñasco Creek	do	84d	5	do
738	Ford of Peñasco Creek at Corral	do	84d	D. M.	do
739	Spring, 2¼ miles north of Elk Spring	do	84d	2	do
740	Roblado Peak	do	84d	2	Camp 53
741	Las Cruces	do	84d	D. M. and 4	Fort Bayar
742	Mesilla Crossing, Rio Grande	do	84d	1	do
743	Capitan Peak	do	85a	8	Fort Craig.
744	Capitan Pass	do	85a	1	Santa Fé
745	Hacheta Peak	do	89b	5	do
746	La Lacha Spring	do	89b	4	do
747	Black Rock Tank	do	90a	2	do
748	Kettle Spring	do	90a	2	do
749	South Florida Peak	do	90a	3	do
750	Las Tenejas	do	90a	2	do
751	Nigger Head Spring	do	90a	2	do
752	Carrizillo Spring	do	90a	2	do
753	Florida Peak	do	90a	3	do
754	Jackson Ranch	do	90c	4	Fort Bayar
755	Cottonwood Springs	do	90c	4	Silver City.
756	North Franklin Peak	do	90c	2	do

The altitudes of points marked thus (*) are from aneroid determinations; all others from barometer.

Table of Altitudes of Points of Interest in and about the Yosemite Valley.[*]

WATERFALLS.

Name.	Height above valley.	Height of fall.	Remarks.
	Feet.	*Feet.*	
ıite Falls, top	2, 550		Measured by theodolite and barometer.
'oot of Upper Fall	1, 114		Measured by barometer.
ower Fall	488		Measured by theodolite.
pper Fall		1, 436	
cond Fall		626	
hird Fall		488	
la Fall, top	1, 957		Measured by barometer.
t foot of fall	1, 352		Do.
la Fall		605	Do.
l Fall, top	1, 125		
l Fall, base	782		Do.
l Fall		343	Do.

se altitudes are referred to floor of upper bridge, 3,851 feet above sea by barometer.
is list is compiled for immediate use from such observations as have been worked up. Additions
made as soon as the computations are completed.

POINTS IN THE VICINITY OF THE VALLEY.

Name.	Height above valley.	Height above sea.	Remarks.
	Feet.	*Feet.*	
Point	2, 356. 0	6, 207. 0	Measured by theodolite.
Point Finger	2, 340. 0	6, 191. 0	Do.
el Rock	3, 069. 0	6, 920. 0	Do.
r Point (railing)	3, 257. 0	7, 108. 0	Do.
ıite Falls flag	2, 593. 0	6, 444. 0	Do.
Point	3, 818. 0	7, 669. 0	Do.
s Rest	5, 921. 5	9, 772. 5	By barometer.
Dome (lip)	4, 953. 0	8, 804. 0	Measured by theodolite.
el Dome	4, 160. 0	8, 011. 0	Do.
Dome	3, 633. 0	7, 484. 0	Do.
bia Rock	1, 154. 0	5, 005. 0	Do.
lral Rock (higher)	2, 678. 0	6, 529. 0	Do.
lral Rock (lower)	2, 579. 0	6, 430. 0	Do.
King	5, 171. 0	9, 022. 0	Do.

PROMINENT PEAKS.

Name.	Height above sea.	Measured by—	Remarks.
	Feet.		
	11, 295	Barometer	Also called Gothic Peak and the Obelisk.
ss	12, 518	do	
	11, 231	do	Near Cathedral Peak.
ann	10, 872	do	
d	11, 442	do	Highest of the Mount Clark Group.
	13, 191	do	
	6, 910	do	
s	7, 153	do	
to	8, 136	do	

TOPOGRAPHICAL MAPS AND PROGRESS-SHEET.

ven regular topographical atlas-sheets, on a scale of 1 inch to 4
, with land-classification areas added, will accompany the extra
s asked for of this report, but are not forwarded for insertion in the
eport of the Chief of Engineers. These are numbered 32 D, 47 B +
, 61 D, 73 A, 78 A, 84 B, and lie in the political divisions of Cali-
a, Nevada, and New Mexico. The large amount of collected topo-

graphical data remaining unpublished (*i. e.*, nearly forty atlas-sheets) would admit of the preparation of a much larger number within a year but the office has not had available draughtsmen.

The progress-map herewith submitted shows the extension of th rectangle scheme eastward to the Mississippi River, thus giving 12 divisions instead of 95, as heretofore. The divisions are of convenient sized areas, and can be used as the basis of a further subdivision, and since the special projection practically limits distortion to a minimum and admits of the conjoining of the sheets, it is respectfully suggeste that all maps hereafter made of this region by the Engineer Departmen might be constructed upon this projection to secure uniformity. Th altitudes of a number of barometer reference-stations have been added and the map brought down to date as nearly as the limited time for i revision has permitted.

LAND CLASSIFICATION AREAS AND MAPS.

Observations upon the varied native resources of the soil and underl ing rock were undertaken as early as 1872, having been required by th instructions of that year. The systematic classification of the land i conjoining areas was only begun, however, in 1874, and has since co tinued with increasing detail year by year without interruption. Wit out appreciable additional time or cost, the measurements, examination and notes required by which to demark the boundaries between trac valuable, for instance, for grazing or as timber, can be made by th assistants engaged in the triangulation and topographical observatio required in the general topographical survey of a given region, an thus the quality of the land becomes known before it is parcelled o into legal subdivisions. It cannot be expected, nor is it claimed, th the results are more than approximate, as no rigid rule can be applie and the judgment of the individual must often decide where, for instanc should be noted the gradation from the grazing to the timber line, alon sloping foot-hills, where the former advances into timbered areas. Th grazing may be either good or bad, it being impracticable in most case to note with accuracy the variations. At most, the percentages give are but approximations.

The agricultural land reported in the accompanying tables is confine to the area that can be cultivated by irrigation, it having been asce tained that a sufficient quantity of water is available, and as the esti mates have been kept *below* a minimum, it is fair to presume that some future period the amount actually cultivated may prove to be i excess of amounts stated, resulting from the small local increase due irrigation itself, not taking into account the periodic changes in rainfal Soil susceptible of cultivation by means of irrigation, and for which wate cannot apparently be had, has been thrown into the division of arid an barren. On account of the expense of publishing in colors, only fou divisions have been shown, *i. e.*, (1) arable or agricultural with irrig tion; (2) arid and barren; (3) timber; (4) pasturage or grazing.

The number of divisions can be largely expanded, however, and late have covered the cases given below that serve as a description o all classes now known to the law in its disposition of the public land *i. e.*:

1. Arable or agricultural, { without irrigation.
{ with irrigation (sufficient water being available), or dra
{ age.

2. Timber, { (1) large } with prevailing species, as live-oak, cedar, &c.
{ (2) small }

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3. Pasturage or grazing, { (1) good / (2) bad } with species and quality of grasses.
4. Arid or barren, including "desert-lands."
5. Swamp, tide, and overflowed.
6. Location of the precious and economic minerals, such as—

1. Gold, in place or placer.
2. Silver.
3. Cinnabar.
4. Copper.
5. Lead.
6. Iron.
7. Coal.
8. Tin or nickel.
9. Antimony and arsenic.
10. Sulphur.
11. Sodium, chloride and carbonate of.
12. Alum and borates.
13. Peats, marls, and clays.
14. Asphaltum, petroleum.

The following table exhibits the approximate percentages found in areas examined that exceed 125,000 square miles. More values will be given as fast as they can be prepared. While the percentage of "arable" appears small, still the area actually "arid and barren," and worthless for agricultural purposes in but one case reaches 53.18 per cent.; while it is to be remarked that quite a number of these atlas sheets embrace some of the most completely desert portions of the United States:

Table of Land Classification.

States or Territories.	Atlas sheet number, as per progress-map herewith.	Number of square miles examined and classified.	Land classification.								Remarks.
			Arable or agricultural, with irrigation.	Approximate percentage of area.	Pasturage or grazing.	Approximate percentage of area.	Timber.	Approximate percentage of area.	Arid or barren.	Approximate percentage of area.	
		Total sq. miles.	*Sq. miles.*	*Pr. cent.*	*Sq. miles.*	*Pr. cent.*	*Sq. miles.*	*Pr. cent.*	*Sq. miles.*	*Pr. cent.*	
Idaho	32 C	4, 022. 58	20. 38	0. 50	2, 247. 85	55. 90	230. 05	5. 70	1, 524. 30	37. 90	To be published.
Idaho, Wyoming	32 D	4, 022. 58	30. 00	0. 73	2, 818. 10	70. 08	1, 000. 36	24. 87	120. 00	2. 98	1.34 per cent. of lakes, ponds, and marshes, or 54.12 square miles. To accompany extra copies Annual Report 1879.
California, Nevada	38 D	4, 127. 18	111. 60	2. 80	3, 115. 10	75. 55	430. 57	10. 15	401. 28	9. 80	1,70 per cent. of lakes, ponds, and marshes, or 68.63 square miles. To be published.
Idaho, Utah	41 A	4, 075. 29	58. 50	1. 45	2, 938. 65	72. 13	441. 24	10. 82	363. 60	8. 90	6.70 per cent. of lakes, ponds, and marshes, or 273.30 square miles. To be published.
Idaho, Utah, Wyoming	41 B	4, 075. 29	971. 40	23. 83	1, 883. 45	46. 21	867. 80	21. 30	132. 10	3. 25	5.41 per cent. of lakes, ponds, and marshes, or 220.54 square miles. Published with extra copies Annual Report 1878.
California	47 A	4, 178. 42	229. 35	5. 50	1, 091. 22	26. 20	2, 636. 10	63. 00	146. 15	3. 50	1.80 per cent. of lakes, ponds, and marshes, or 75.60 square miles. To be published.
California, Nevada	47 B	4, 178. 42	120. 68	2. 89	526. 10	12. 59	625. 25	14. 96	2, 227. 94	53. 32	16.24 per cent. of lakes, ponds, and marshes, or 678.45 square miles. To accompany extra copies Annual Report 1879.
Do	47 D	4, 228. 56	....	....	....	....	....	....	....	....	—— per cent, of lakes, ponds, and marshes, or —— square miles. To accompany extra copies Annual Report 1879.
Colorado	53 C (P)	1, 590. 86	135. 34	8. 50	906. 44	57. 00	477. 58	30. 00	71. 50	4. 50	Published as topographical sheet only.
Do	61 A	4, 278. 00	233. 00	5. 45	2, 217. 00	51. 82	1, 493. 00	34. 90	335. 00	7. 83	Published with extra copies Annual Report 1878.
Do	61 B	4, 278. 00	403. 00	9. 41	757. 00	17. 70	2, 223. 00	51. 98	895. 00	20. 91	Published with extra copies Annual Report 1877.
Do	61 C	4, 326. 29	59. 67	1. 37	410. 21	9. 48	2, 670. 31	61. 73	1, 186. 10	27. 42	Published with extra copies Annual Report 1878.
Do	61 D	4, 326. 29	443. 29	10. 24	1, 470. 00	34. 00	1, 232. 00	28. 46	1, 181. 00	27. 30	To be published.
Do	62 A	4, 278. 00	291. 00	6. 80	2, 970. 00	69. 42	773. 00	18. 07	244. 00	5. 71	Published with extra copies Annual Report 1878.
Do	62 C	4, 326. 29	197. 00	4. 62	2, 773. 20	64. 11	1, 151. 09	26. 42	205. 00	4. 85	Do.
California	65 D	4, 420. 20	67. 00	1. 50	2, 132. 00	48. 20	430. 00	9. 70	1, 791. 20	40. 60	Published with extra copies Annual Report 1877.

Colorado, New Mexico	69 (P)	16, 059. 52	930. 68	5. 80	8, 334. 26	51. 90	5, 836. 90	36. 35	957. 68	5. 95	69 B. Published with extra copies Annual Report 1877. 69 D. Published with extra copies Annual Report 1878. 69 (P). To be published.
Colorado, New Mexico	70 A	4, 373. 74	168. 00	3. 88	1, 412. 00	32. 25	2, 536. 74	58. 00	257. 00	5. 87	Published with extra copies Annual Report 1877.
New Mexico	70 C	4, 420. 20	155. 00	3. 51	2, 797. 20	63. 28	1, 328. 00	30. 05	140. 00	3. 16	Do.
Arizona	75	17, 952. 24	796. 24	4. 40	7, 154. 00	39. 90	2, 614. 00	14. 60	7, 388. 00	41. 10	Published as topographical sheet only.
New Mexico	77 B	4, 465. 85	193. 00	4. 32	2, 537. 85	56. 84	1, 015. 00	22. 73	720. 00	16. 11	Published with extra copies Annual Report 1877.
Do	77 D	4, 510. 27	88. 04	1. 92	3, 309. 43	73. 18	933. 34	20. 70	188. 46	4. 20	Published with extra copies Annual Report 1878.
Do	78 A	4, 465. 85	84. 03	1. 88	3, 430. 22	76. 82	804. 52	18. 01	147. 08	3. 29	Published with extra copies Annual Report 1879.
Arizona, New Mexico	83 (P)	13, 573. 47	228. 09	1. 65	5, 850. 17	43. 12	4, 441. 61	32. 80	3, 053. 60	22. 43	Published as topographical sheet only.
New Mexico	84 B	4, 554. 13	32. 00	0. 70	3, 480. 27	76. 40	871. 60	19. 20	170. 26	3. 70	To accompany extra copies Annual Report 1879.

NOTE.—(P) after the atlas-sheet number signifies that only a portion of the sheet has been classified.

Adverting to the mooted question of a change in the system, or rather of the size and shape of the tracts of land to be parcelled out to the settler, it may be said that, should a classification resulting from observations made by topographical engineers engaged in a general survey be developed to embrace the whole public domain, an intelligent idea could then be formed of the necessity therefor; and, *ad interim*, the rights of the settler now occupying in advance of the land-survey, as well as those electing meanwhile to homestead upon the public domain, would be preserved under existing laws, the government thereby reserving all its rights as trustee; and, indeed, no change should be made in the present subdivision of the townships until the government is possessed of full information upon which to base a new plan, such as could alone result from a complete and exhaustive classification of the entire area remaining unparcelled. The number of land-classification sheets published to date is twenty-one, and twelve others are in various stages of completion.

ROUTES OF COMMUNICATION.

Lists of distances over the most important routes of the regions visited by the several main parties, prepared under the supervision of each chief of party, are herewith given.

The special report, giving lists of geographical positions, altitudes, distances, &c., being again delayed, will contain a combined exhibit of all prominent route-distances obtained up to and including 1879.

LIST OF DISTANCES BETWEEN PROMINENT POINTS MEANDERED BY PARTY NO. 2, COLORADO SECTION, 1878.

Fort Bliss, Tex., to Fort Craig, N. Mex.
Fort Stanton, N. Mex., to Fort Bliss, Tex.

From Fort Bliss, Tex., to Fort Craig, N. Mex.—Atlas-sheets Nos. 90 and 84.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Fort Bliss.	From Fort Craig.		
Fort Bliss	....	....	147.86	3,622.9	Three-company post.
Jackson's Ranch (or Cottonwoods)	25.24	25.24	122.62	3,737.8	Government agency; wood, water, and grazing.
Las Cruces	21.11	46.35	101.51	3,808.5	Town; government agency.
Doña Ana	6.05	52.40	95.46	....	Town.
Fort Selden	9.39	61.79	86.07	3,900.0	Wood, water, and grazing.
Point of Rocks	19.87	81.66	66.20	4,268.3	Stage-station; water and grazing; fuel scarce.
Aleman	17.53	99.19	48.67	4,594.3	Martin's Well; government agency; good grazing.
Toussaint's Ranch	21.08	120.27	27.59	4,634.0	Government agency; water in tanks; good grazing.
Paraje	18.52	138.79	9.07	4,319.2	Mexican town; government agency; no grazing.
Ferry	3.37	142.16	5.70	....	Crossing of the Rio Grande.
Fort Craig	5.70	147.86	....	4,447.5	Good grazing; water plenty.

From Aleman to Fort McRae, 16.93 miles.
From Fort McRae to Touissaints, 12.36 miles.
Road follows east bank of Rio Grande and crosses river at ferry. Fort Craig is on west bank

From Fort Stanton, N. Mex., to Fort Bliss, Tex.—Atlas-sheet No. 84.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Fort Stanton.	From Fort Bliss.		
Fort Stanton	....	....	160. 67	6, 151. 5	Four-company post.
Dowlin's Mill	20. 88	20. 88	139. 79	6, 491. 0	Government agency; good grazing.
Blazar's Mill	18. 18	39. 06	121. 61	6, 448. 6	Do.
Tularosa	17. 27	56. 33	104. 34	4, 357. 5	Government agency; town.
White Sands	25. 78	82. 11	78. 56	3, 888. 3	Water strongly alkaline; poor grazing; little fuel.
Shedd's Ranch	30. 80	112. 91	47. 76	4, 378. 0	Government agency; good grazing.
Fort Bliss	47. 76	160. 67	....	3, 622. 9	Three-company post.
White Sands	....	....	35. 07	3, 888. 3	
San Nicolas Spring	17. 07	17. 07	18. 00	4, 218. 0	Good water; fuel and poor grazing.
Shedd's Ranch	18. 00	35. 07	....	4, 378. 0	
Shedd's Ranch—					
Fort Selden	28. 62	....	....	....	
Las Cruces	19. 80	....	....	....	

LIST OF ROAD-DISTANCES BETWEEN PROMINENT POINTS MEANDERED BY PARTY NO. 1, UTAH SECTION, 1878.

Chico, Cal., to Taylorville, Cal.
Chico, Cal., to Sesma, Cal.
Sesma, Cal., to Prattville, Cal.
Oroville, Cal., to Quincy, Cal.
Quincy, Cal., to Taylorville, Cal.
Taylorville, Cal., to Quincy, Cal.
Red Bluff, Cal., to Susanville, Cal.
Susanville, Cal., to Red Bluff, Cal.

From Chico to Taylorville, Cal.—Atlas-sheets Nos. 47 *C and A.*

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Chico.	From Taylorville.		
Chico, post-office	....	....	91. 12	177. 3	Via Butte Creek road, Prattville, and Arlington Bridge.
Centerville	12. 95	12. 95	78. 17	502. 5	Wood and water; no pasturage.
Hupp's Mill	9. 55	22. 50	68. 62	2, 667. 0	Do.
Inskip	10. 71	33. 21	57. 91	4, 808. 3	Do.
Chapperal House	3. 90	37. 11	54. 01	5, 076. 0	Do.
Butte Creek House	7. 67	44. 78	46. 34	5, 758. 1	Wood, water, and pasturage.
Longville	11. 63	56. 41	34. 71	4, 309. 0	Toll-gate; water; pasturage.
Prattville	8. 67	65. 08	26. 04	4, 394. 1	Town; pasturage.
Greenville	14. 91	79. 99	11. 13	3, 543. 8	Pasturage near town.
Crescent City	4. 98	84. 97	6. 15	3, 306. 0	Do.
Arlington Bridge	1. 30	86. 27	4. 85	3, 375. 0	Pasturage, wood, and water.
Taylorville	4. 85	91. 12	....	3, 479. 0	Do.

From Chico to Taylorville, Cal.—Atlas-sheets Nos. 47 C and A—Continued.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Chico.	From Taylorville.		
Chico	....	....	89. 826	177. 3	Via Chico Creek toll-road, Prattville, and Deadfall Bridge.
Weld's	15. 980	15. 980	73. 846	2, 217. 4	Wood and water; no pasturage.
Lomo	13. 566	29. 546	44. 300	3, 847. 8	Do.
Colby's	9. 884	39. 430	50. 396	4, 989. 7	Wood, water, and pasturage.
Toll-gate	8. 380	47. 810	42. 016	5, 426. 6	Do.
Butte Creek Bridge	8. 108	55. 918	33. 908	4, 691. 6	Do.
Prattville	7. 418	63. 336	26. 490	4, 394. 1	Town; pasturage.
Greenville	14. 910	78. 246	11. 580	3, 543. 8	Do.
Deadfall Bridge	9. 730	87. 976	1. 850	3, 426. 0	Wood, water, and pasturage.
Taylorville	1. 850	89. 826	....	3, 479. 0	Town; pasturage.

From Chico to Sesma, Cal.—Atlas-sheets Nos. 46 B and D.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Chico.	From Sesma.		
Chico	....	....	26. 696	177. 3	Town.
Phillip Ranch	12. 138	12. 138	14. 558	242. 1	Ranch; wood scarce; water and pasturage.
Sesma	14. 558	26. 696	....	260. 0	Williamson's store.

From Sesma to Prattville, Cal.—Atlas-sheets Nos. 46 B and 47 A.

Sesma	....	....	61. 653	259. 7	Via Lassen's old trail; abandoned wagon-road.
Deer Creek Meadows	44. 000	44. 000	17. 653	4, 518. 1	Junction Deer and Lost Creeks, lower end meadows.
Prattville	17. 653	61. 653	....	4, 394. 1	Town.

From Oroville to Quincy, Cal.—Atlas-sheets Nos. 47 C and A.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Oroville.	From Quincy.		
			64. 384	187. 5	At Toll Bridge over river.
's Bar	9. 500	9. 500	54. 884	342. 1	Good water; no grass; forage obtainable.
reek	9. 096	18. 596	45. 788	1, 887. 2	Do.
n House	10. 512	29. 108	35. 276	3, 562. 2	Do.
e	5. 325	34. 433	29. 951	4, 938. 0	Stage station.
Ranch	13. 368	47. 801	16. 583	5, 112. 2	Good pasturage obtainable.
e	5. 605	53. 406	10. 978	5, 426. 6	Unfit for camping.
Valley	2. 380	55. 786	8. 598	3, 757. 0	Wood and water; forage obtainable.
Ranch	1. 932	57. 718	6. 666	3, 636. 0	Wood and water; pasturage obtainable.
	6. 666	64. 384		3, 381. 0	Wood and water; forage and pasturage.

From Quincy to Taylorville, Cal.—Atlas-sheet No. 47 A.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Quincy.	From Taylorville.		
			21. 170	3, 381	Forage and pasturage obtainable.
Bridge	12. 90	12. 900	8. 270	3, 071	
on Bridge	3. 42	16. 320	4. 850	3, 375	
le	4. 85	21. 170		3. 479	Forage and pasturage obtainable.
				3, 381	Via old toll-road.
ille	15. 30			3, 479	Taylor's Hotel.

From Taylorville to Quincy, Cal.—Atlas-sheet No. 47 A.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Taylorville.	From Quincy.		
le			81. 438	3, 479. 0	Taylor's Hotel.
kus' Ranch	6. 875	6. 875	74. 563	3, 635. 0	Genesee Valley.
y's Ranch	3. 966	10. 841	70. 597		Pasturage and forage obtainable.
's Ranch	11. 500	22. 341	59. 097	5, 387. 0	Do.
Ranch	7. 500	29. 841	51. 597	5, 464 0	Do.
rth's Store	9. 400	39. 241	42. 197	4, 887. 2	Forage.
's Ranch	9. 371	48. 612	32. 826	4, 840. 0	Pasturage.
s Ranch	16. 256	64. 868	16. 570	4, 135. 7	Do.
	16. 570	81. 438		3, 381. 0	Town.

***From Hosselkus' to Bagley's Ranch the distance is estimated by pacing.**

From Red Bluff to Susanville, Cal.—Atlas-sheets Nos. 46 B and A.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Red Bluff.	From Susanville.		
Red Bluff	......	......	107.936	307.6	Railroad track at depot, from railroad profiles.
Bell Mill	37.229	37.229	70.707	3,681.2	No feed; wood and water.
Battle Creek Meadows	9.728	46.957	60.979	4,699.7	Toll-gate; wood and water; pasturage.
*Tyler's Ranch	8.455	55.412	52.524	4,801.7	Wood and water; pasturage.
*Willow Creek	10.250	65.662	42.274	....	Wood and water; no pasturage.
Warner Creek Bridge	1.479	67.141	40.795	4,826.2	Do.
Forks of road near Martin's Ranch	5.500	72.641	35.295	4,464.0	To Prattville, along west side Big Meadows, 9.324 miles.
Forks of road near Mitchell's Ranch	4.670	77.311	30.625	4,713.4	To Prattville, along east side Big Meadows, 17.200 miles.
Goodrich's Ranch	12.365	89.676	18.260	4,883.0	
Susanville	18.260	107.936	......	4,195.0	Town; post-office.

*From Tyler's Ranch to Willow Creek, distance estimated.

From Susanville, to Red Bluff, Cal.—Atlas-sheets Nos. 47 A and 46 B.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Susanville.	From Red Bluff.		
Susanville	......	......	133.123	4,195.1	Via Pine Creek, Canoe Creek and Ogburn's Ranch to Jelly's Ferry.
*Forks road (near Stockton's Mill)	7.185	7.185	125.938	5,036.4	Wood, water, pasturage at Stockton's.
Bridge Creek	12.000	19.185	113.938	5,508.6	Wood, water, grazing.
Pine Creek	10.000	29.185	103.938	5,409.1	Do.
Canoe Creek	26.700	55.885	77.238	4,277.0	Wood, water, grazing one mile below junction Lost and Hat Creek.
Loomis' Ranch	20.724	76.609	56.514	4,356.5	Wood, water, pasturage at Smith's, distance 0.5 mile.
Ogburn's Ranch	17.050	93.659	39.464	2,269.5	Do.
†Jelly's Ranch	27.464	121.123	12.000	360.0	Do.
Red Bluff (via ferry)	12.000	133.123	....	307.6	Town; altitude at railroad depot.

* From forks of road, near Stockton's Mill, to Pine Creek the distance was estimated by pacing.
† From Red Bluff to Jelly's Ranch popular estimate of distance given.

LIST OF ROAD DISTANCES BETWEEN PROMINENT POINTS MEANDERED BY PARTY NO. 2, UTAH SECTION, 1878.

Bakersfield to Caliente, Cal.
Caliente to Twin Lakes, Cal.
Caliente to Havilah, Cal.
Houlton's Ranch to Lone Valley Mines, Cal.
Kern River Bridge to Wilkes' Ranch, Cal.
Little Elizabeth Lake to San Fernando Mission, Cal.
Roberts' Ranch to Weldon, Cal.
Tapo Ranch to Hueneme, Cal.
Miscellaneous distances, California.

From Bakersfield to Caliente, Cal.—Atlas-sheet No. 73 *A.*

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Bakersfield.	From Caliente.		
Bakersfield	......	......	......	....	Railroad station.
Pampa	16. 48	......	......	....	By road. No grass; no wood.
Caliente	7. 22	23. 70	......	....	No trail, via the cañon.

From Caliente to Twin Lakes, Cal.—Atlas-sheet No. 73 *A.*

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Caliente.	From Twin Lakes.		
Caliente	......	......	43. 33	....	
Beale Station	1. 57	1. 57	41. 76	....	By road. On the Southern Pacific Railroad.
Soap Creek	15. 16	16. 73	26. 60	....	By road and trail. Water, wood, and grass here.
Tejon Ranch	9. 97	26. 70	16. 63	....	By trail. Farming and grazing country.
McKenzie's	11. 16	37. 86	5. 47	....	By road. Tejon Creek.
Twin Lakes	5. 47	43. 33	......	....	By trail. Old emigrant camping ground. Good water and wood; grass scanty.

From Caliente to Havilah, Cal.—Atlas-sheet No. 73 *A.*

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Caliente.	From Havilah.		
Caliente	......	....	52. 25	....	
Pampa	12. 37	12. 37	39. 88	....	Via Kernville stage road.
Stark's Ranch	1. 03	13. 40	38. 85	....	Walker's Basin Creek.
Kern River	9. 84	23. 24	29. 01	....	Mouth Cottonwood Creek. Barker's Ranch, 1 mile below.
Mouth of Kern River Cañon	2. 02	25. 26	26. 99	....	
Oak Creek	4. 42	29. 68	22. 57	....	Water and grass scanty.
Kerr Creek	3. 96	33. 64	18. 61	....	Spring of water ¼ mile below crossing of road.
Breckenridge Mountain	9. 63	43. 27	8. 98	....	Jewitt's Ranch.
Havilah	8. 98	52. 25	....	....	

This route is very circuitous. The direct road from Caliente to Havilah and Kernville was surveyed in 1875.

From Stark's Ranch to Breckenridge Mountain, by trail; from Breckenridge Mountain to Havilah, by road.

From Houlton's Ranch to Lone Valley Mines, Cal.—Atlas-sheet No. 73 D.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Houlton's Ranch.	From Lone Valley Mines.		
Houlton's			54.63		Large grazing ranch.
Forks of the Mojave	5.26	5.26	49.37		By road. But little water and wood in ance.
Rattlesnake Spring	16.97	22.23	32.40		By road, to the left main road.
Cox's Cabin	3.78	26.01	28.62		By road; good grazing, and wood.
Green Lead Mining Camp	6.43	32.44	22.19		By road; deserted nc
Holcomb Valley	7.52	39.96	14.67		By road; placer and mines; small settle
Bear Valley	4.34	44.30	10.33		By road; mining tow age may be purchas
Lone Valley Mines	10.33	54.63			By trail; no grass; scarce.

From Kern River Bridge to Wilkes' Ranch, Cal.—Atlas-sheet No. 73 A.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Kern River Bridge.	From Wilkes' Ranch.		
Kern River Bridge			37.52		Stage crossing; so Kernville.
Keysville	1.83	1.83	35.69		By road; old mining
Dahlonega Hot Springs	10.19	12.02	25.50		By road and trail o River.
Poso Creek	12.87	24.89	12.63		Poor trail; mouth of Gulch.
Mouth of Little Poso Creek	3.04	27.93	9.59		Trail.
Poso Flat	4.94	32.87	4.65		Trail; Gardet's Ranch vated ground.
Wilkes' Ranch	4.65	37.52			On the county road.

From Little Elizabeth Lake to San Fernando Mission, Cal.—Atlas-sheet No. 73

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Elizabeth Lake.	From San Fernando Mission.		
Little Elizabeth Lake			45.08		Entrance to Castac numerous farms he
Forks of Castac Creek	19.36	19.36	25.72		No trail; via Castac
Newhall's Ranch	6.35	25.71	19.37		By road; Santa Clara
Leighton's	7.04	32.75	12.33		By road; store and on the road to the P wells.

rom Little Elizabeth Lake to San Fernando Mission, Cal., &c.—Continued.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Elizabeth Lake.	From San Fernando Mission.		
s	3.54	36.29	8.79	....	By road; grain and grazing ranch.
of trail	2.20	38.49	6.59	....	By trail.
nando Tunnel	1.13	39.62	5.46	....	By trail; Southern Pacific Railroad.
tation	4.10	43.72	1.36	....	By road.
ndo Mission	1.36	45.08	....	....	By road; gardens and grain ranches.

From Roberts' Ranch to Weldon, Cal.—Atlas-sheet No. 73 A.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Roberts' Ranch.	From Weldon.		
Ranch	....	....	52.14	....	South Fork Kern River.
ebrake	5.63	5.63	46.51	....	Ranch here; good camping-ground.
. Walker's Pass	6.23	11.86	40.28	....	
Holes	7.28	19.14	33.00	....	On the desert; stage station; water plenty; feed scarce.
ring	12.28	31.42	20.72	....	Good spring; no grass; no wood.
	21.72	52.14	....	....	Farming country.

Continuous road from Roberts' Ranch to Weldon.

From Tapo Ranch to Hueneme, Cal.—Atlas-sheet No. 73 C.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Tapo Ranch.	From Hueneme.		
ch	....	....	51.39	....	Vineyard and cultivated ground.
nch	7.14	7.14	44.25	....	By road; country devoted to sheep-raising.
as Ranch	12.42	19.56	31.83	....	By road; grain and sheep ranch.
rusalem	11.95	31.51	19.88	....	By road; good farming country.
naventura	8.08	39.59	11.80	....	By road; at the old mission church.
	11.80	51.39	....	....	Along the coast; no trail; harbor and wharves here.

Miscellaneous distances, California—Atlas-sheet No. 73 C.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From—	From—		
Calleguas Ranch			7.61		Wine ranch.
Conejo Hotel	7.61	7.61			By road; in the Conejo Valley; grain and grazing in abundance.
Springville			27.58		Farming country.
Conejo Hotel	15.81	15.81	11.77		By road.
Newberry Park	4.39	20.20	7.38		By road; oak forests.
Mill's Ranch	1.97	22.17	5.41		By road.
The Potrero	5.41	27.58			By road; large and fertile valley; numerous ranches.
Mill's Ranch			9.17		
Vejar's Ranch	9.17	9.17			By road, via Triunfo Creek.

Miscellaneous distances, California—Atlas-sheet No. 73 C.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From—	From—		
Los Angeles			20.22		
Half-way House	9.24	9.24	10.98		By road; on the Santa Monica road.
Santa Monica	6.92	16.16	4.06		By road; summer résort.
Old Santa Monica	1.80	17.96	2.26		Along the coast; mouth of Santa Monica Creek.
Santa Inez Cañon	2.26	20.22			Along the coast; no grass; water poor; wood scarce.
Los Angeles			4.03		
Sycamore Grove	4.03	4.03			By road; pic-nic grounds in the Arroyo Seco.
San Gabriel Mission			33.09		
Roberts' Ranch	13.52	13.52	19.57		By road; mouth of San Gabriel Cañon.
Winston Silver mines	3.44	16.96	16.13		By road; feed in San Gabriel Cañon very scarce; scanty bunch grass in places; wood and water abundant.
Forks of San Gabriel Creek	5.76	22.72	10.37		
San Gabriel Mines	2.21	24.93	8.16		
Mouth of Cattle Cañon	2.81	27.74	5.35		By road; cattle range in this cañon; good trout-fishing.
The Narrows	5.35	33.09			By trail; cañon impassable farther.

Miscellaneous distances, California.—Atlas-sheet No. 73 D.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From—	From—		
Kincaid's Ranch			4.06		Mouth of San Antonio Cañon.
The Falls	4.06	4.06			Cienega at the foot of the rapids.
Kincaid's Ranch			24.62		Fruit and grain ranch.
Cucamonga	6.40		18.22		By road; large vineyards here.
San Bernardino	18.22	24.62			By road; town.
Forks of Santa Ana River			16.65		Grass very scarce; meadow a few miles above.
Fish-pond Ranch	5.80	5.80	10.85		By trail; Good grazing here.
Mountain Home	5.83	11.63	5.02		By trail; summit of pass; no feed; wood and water abundant.
Forsee's Ranch	5.02	16.65			By trail: on Mill Creek.

Miscellaneous distances, California.—Atlas-sheet No. 73 D.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From—	From—		
San Bernardino			12.68		
Devil's Cañon Toll-house	7.86	7.86	4.82		By road; good camping-ground.
Summit	4.04	11.90	.78		By road.
Clipper Saw-mill	0.78	12.68			By road; road from here to Houlton's Ranch.
Summit			11.86		
Fiddler's Tannery	4.69	4.69	7.17		Old road; wood, water, and grass.
Whiskey Johnny's	4.69	9.38	2.48		Old road; summit of toll-road.
Little Bear Valley	2.48	11.86			By road; large grazing area; saw-mills here.
Waterman's Hot Springs			16.66		Fruit and grain ranch; resort for invalids.
San Bernardino	6.08	6.08	10.58		
Colton	3.24	9.32	7.34		Railroad station for San Bernardino.
Riverside	7.34	16.66			Orange-growing region.

LIST OF DISTANCES BETWEEN PROMINENT POINTS MEANDERED BY PARTY NO. 2, CALIFORNIA SECTION, 1878.

Camp Bidwell, Cal., to Fort Klamath, Oreg.
Fort Klamath, Oreg., to Warm Spring Agency, Oreg.
Warm Spring Agency, Oreg., to The Dalles, Oreg.
The Dalles, Oreg., to Lower Cascades, Oreg.

The Dalles, Oreg., to ferry at Grant's Landing, and thence to Tygh Valley, vi Shear's Bridge, Oreg.
Warm Spring Agency, Oreg., to Camp Bidwell, Cal.
Oak Grove, Oreg., to Toll-gate Well of Mount Hood, via new grade.
Summit Prairie, near Mount Hood, to Tygh Valley, via Barlow's Toll-gate.
Old Camp Watson, Oreg., to Camp Bidwell, Cal.
The Dalles, Oreg., to Old Camp Watson, Oreg.
Camp Bidwell, Cal., to Reno, Nev.

From Camp Bidwell, Cal., to Fort Klamath, Oreg.—Atlas-sheet No. 38 A and B, and 29

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Camp Bidwell.	From Fort Klamath.		
Camp Bidwell	....	....	145.8	....	Two-company post.
Willow Ranch	16.89	16.89	128.91	....	Small settlement; wate wood, and grass.
Lake View	19.21	36.10	109.70	....	Small town; United Stat Land Office; water, woo and grass.
Phelp's Ranch	20.34	56.44	89.36	....	Water, wood, and grass.
Prine's Ranch	28.39	84.83	60.97	....	Good grazing, water, a wood.
Yainax	16.34	101.17	44.63	....	Sub-agency for Klamath I dians; water, wood a grass.
Klamath Agency	38.53	139.70	6.1	....	Water, wood, and grass.
Fort Klamath	16.1	145.8	....	....	Two-company post; go grazing; water and wo in vicinity.

From Fort Klamath to Warm Spring Agency, Oreg.—Atlas-sheets Nos. 29 C, 29 A, and 20

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	Fort Klamath.	From Warm Spring Agency.		
Fort Klamath	....	....	202.25	4,108.4	Two-company post; wat wood, and grass in vicini
Klamath Agency	6.1	6.1	196.15	....	
Williamson River	11.7	17.8	184.45	4,387.0	Good water, wood, and gra
Big Springs	22.85	40.65	161.60	4,552.5	Do.
Corral Springs	21.64	62.29	139.96	4,782.6	Do.
Little Meadows, on East Fork of Des Chutes.	17.10	79.39	122.86	4,258.2	Good grazing, water, a wood.
East Fork of Des Chutes	21.74	101.13	101.12	4,081.1	Do.
Big Meadows	13.90	115.03	87.22	4,123.7	Do.
Farewell Bend	15.80	130.83	71.42	3,620.9	Good grazing, wood, a water off the road; ra taken up near road a fenced in.
Cărmical's, on Crooked River	25.84	156.67	45.58	2,736.2	Poor grazing; a little wo water good; forage can bought.
Luera Ranch	15.1	171.77	30.48	2,443.4	Water, wood, and grass.
Sheep Ranch	10.83	182.60	19.65	....	Do.
Lodge Pole Creek	13.73	196.33	5.92	....	Good water and grass; w scarce.
Des Chutes Ferry	3.61	199.94	2.31	....	Grass and wood scarce.
Warm Spring Agency	2.31	202.25	....	1,573.9	Wood scarce; grass on h in vicinity.

From Warm Spring Agency to The Dalles, Oreg.—Atlas-sheets Nos. 20 C and 20 A.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Warm Spring Agency.	From The Dalles, Oregon.		
Warm Spring Agency	....	....	74. 25	1, 513. 9	Wood scarce; grass on hills in vicinity.
Neenee Spring	20. 45	20. 45	53. 80	2, 914. 2	Good water; wood and grass.
Oak Grove	6. 25	26. 70	47. 55	2, 414. 5	Small settlement; water, wood, and grass.
Tygh Valley	15. 76	42. 46	31. 79	1, 088. 8	Settlement; forage has to be bought.
Fifteen-mile Creek	17. 00	50. 46	14. 79	1, 266. 7	Do.
The Dalles, Oregon	14. 79	74. 25	....	134. 7	Large town on Columbia River.

Distances estimated to Fifteen-mile Creek.

From The Dalles to Lower Cascades, Oreg.—Atlas-sheet No. 20 A.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From The Dalles, Oregon.	From Lower Cascades.		
The Dalles	....	....	50. 05	134. 7	Large town.
Mosher Creek	13. 01	13. 01	37. 04	....	Water, wood, and grass.
Herk's Ranch	5. 70	18. 71	31. 34	....	Grass scarce; water and wood; forage can be purchased.
Hood River	4. 39	23. 10	26. 95	260. 0	Ranch; grass scarce; water and wood; forage can be purchased.
Hood River Post-office	0. 51	23. 61	26. 44	....	Ranch.
Hotel	0. 6	24. 21	25. 84	....	No grass; water and wood.
Upper Cascades	20. 89	45. 19	4. 95	126. 6	Good grass; wood.
Lower Cascades	4. 95	50. 05	....	....	Do.

From The Dalles to Ferry at Grant's Landing, and thence to Tygh Valley via Shcar's Oreg.—Atlas-sheet No. 20 A.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From The Dalles.	From Tygh Valley.		
The Dalles	....	....	84.82	134.7	Large town.
Five-mile House	6.55	6.55	77.27	....	Junction of Eight a Mile Creeks; countr barren; no wood.
Fifteen-mile Creek	5.10	11.65	72.17	....	Grass scarce; no wooc
Bridge over Des Chutes River, near Celilo.	5.62	17.27	66.55	165.8	Ranch; no wood; gras forage for sale here
Ranch	10.19	27.46	56.36	....	Water and grass; wc scarce.
Springs in ravine near Grant's Landing.	1.21	28.67	55.15	....	Good water; grass ar scarce.
Eaton's Ranch Post-office	8.8	37.47	47.35	....	Good grazing and w wood.
Barnum's Ranch	11.32	48.79	36.03	1,795.2	Grass valley; no woc water and grass.
Shear's Bridge	28.54	77.33	7.49	2,006.9	No wood; grass sca age can be purchas
Tygh Valley	7.59	84.82	....	1,088.8	Settlement; forage l purchased; some on hills surroundin ment.

From Warm Spring Agency, Oreg., to Camp Bidwell, Cal.—Atlas-sheets Nos. 29 A, 3 C, and 29 C.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Warm Spring Agency.	From Camp Bidwell.		
Warm Spring Agency	....	....	258.09	1,513.9	Wood scarce; grass in vicinity.
Lodge-pole Creek	5.92	5.92	252.17	1,648.3	Good grass and wate scarce.
Willow Creek	20.72	26.64	231.45	3,079.6	Water, wood, and gı
Prineville	21.02	47.66	210.43	2,899.0	Large town; forage purchased; wood a on hills in vicinity
Green's Ranch	25.90	73.56	184.53	4,479.0	Water, wood, and gı
Waterhole	12.8	86.36	171.73	....	No wood; good gras in deep hole.
Langton's Ranch	17.71	104.07	154.02	5,162.9	Water, wood, and gı
Button's Ranch	22.9	126.97	131.12	4,236.7	Wood, none; wate grass, scarce; for be purchased.
Durand's Ranch (Silver Lake)	19.9	146.87	111.22	4,312.0	Forage has to be pu
Parton's Ranch (Summer Lake)	15.91	162.78	95.31	4,497.6	Water, wood, and gı
Miller's Ranch (Summer Lake)	17.31	180.09	78.00	4,420.3	Do.
Chewaucan	8.93	189.02	69.07	....	
Moss's Ranch	11.67	200.69	57.40	4,827.8	Forage has to be pu
Saw-mill	9.52	210.21	47.88	....	Grass and water on vicinity.
Lake View	17.87	228.08	30.01	4,851.0	Settlement; U. S. laı water, wood, and
Cottonwood Creek	18.7	246.78	11.31	5,228.9	Plenty of good wate and grass; new gr
Camp Bidwell	11.31	258.09	....	4,647.0	Two-company post grade.

ak Grove to Toll-gate west of Mount Hood, Oreg., via new grade.—Atlas-sheet No. 20 A.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Oak Grove.	From Toll-gate.		
ove	......	......	49.22	2,414.5	Settlement; grass, wood, and water.
s Prairie	17.5	17.5	31.72	3,019.8	Water, wood, and grass.
rairie	12.71	30.21	19.01	3,334.8	Water, wood, and grass; rather swampy.
mit Prairie	8.3	38.51	10.71	3,694.2	Station; forage can be bought; some grass on meadows near there.
rnment Camp	2.27	40.78	8.44	....	Water, wood, and grass; rather marshy.
e, foot of range	8.44	49.22	....	....	Wood and water; forage must be bought.

n this place only the ascent of Mount Hood is possible.
l grass can be found on slope of Mount Hood, about 1.5 miles northeast of government camp.

Summit Prairie, near Mount Hood, to Tygh Valley, via Barlow Toll-gate.—Atlas-sheet No. 20 A.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Summit Prairie.	From Tygh Valley.		
it Prairie	......	......	39.04	3,694.2	Station; forage can be bought; grass on some meadows near by.
e River	11.64	11.64	27.40	3,000.3	Wood and water; grass rather scarce.
w Toll-gate or Stricklin's ch.	14.52	26.16	12.88	....	Water, wood, and grass; ranch.
alley	12.88	39.04	....	1,111.4	Settlement; forage must be purchased.

*From this place only the ascent of Mount Hood is possible.

From Old Camp Watson, Oreg., to Camp Bidwell, Cal.—Atlas-sheets Nos. 20 *D*, 29 *B*, 29 *and* 38 *B.*

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Old Camp Watson.	From Camp Bidwell.		
Old Camp Watson			243.27		
McNeal's Ranch	4.00	4.00	239.27		Good water and grass.
Old Military Road	5.56	9.56	233.71		
Small Prairie	1.30	10.86	232.41		Good water and grass.
Creek	5.50	16.36	226.91		Do.
Summit Prairie	4.55	20.91	221.36		Do.
Ranch, Panlina Valley	13.20	34.11	208.16		Do.
Prineville and Harney Road	3.55	37.66	204.61		
Wolf Creek (settlement)	2.90	40.56	201.71		Good water; feed can bought.
Ranch (Beaver Creek, near mouth of Grindstone Creek).	3.45	44.01	198.26		Do.
Big Spring	3.88	47.89	194.38		Good water and grass.
Ranch	1.90	49.79	192.48		Good water; feed can bought.
Prineville and Harney Road	4.50	54.29	187.98		
Spring, head of Grindstone Creek	1.35	55.64	186.63		Good water and grass.
Dillard & Renshaw's Ranch, Twelve-mile Creek.	4.86	60.50	181.77		Water and grass.
Forks of road, near mouth of Long Hollow.	1.90	62.40	179.87		
Spring in Long Hollow	3.85	66.25	176.02		Good water and grass.
Spring near head of Long Hollow	3.70	69.95	172.32		Do.
Buck Creek	2.10	72.05	150.22		Do.
Forks of road	2.55	74.60	167.67		
Alkali Flat	7.30	81.90	160.37		
Camp Curry	2.90	84.80	157.47		Good water and grass.
Bernard's Battle Ground	12.86	97.66	144.61		Do.
Hoskin's Ranch	11.44	109.10	133.17		Do.
Harney Lake Valley	1.79	110.89	131.38		Good grass.
Harney Road	6.98	117.87	124.40		
Warm Spring	0.92	118.79	123.48		Good water and grass.
Buzzard Cañon	11.43	130.22	112.05		Water and grass.
Mule Spring	24.98	155.20	87.07		Good water and grass.
North end Warner Valley	4.60	160.80	82.47		
Fork of roads	7.09	167.89	75.38		
Do	7.20	175.09	68.18		
Do	18.23	193.32	49.95		
Do	2.25	195.57	47.70		
Honey Creek	0.35	195.92	47.35		Good water and grass.
Jones' Ranch	1.15	197.07	46.20		Do.
Fork of roads	3.15	200.22	43.05		
Wallace's Ranch, Deep Creek	13.65	213.87	29.40		Good water and grass.
Twenty-mile Creek, south end of Warner Valley.	6.30	220.17	23.10		Do.
Fork of road, Twelve-mile Creek.	9.55	229.72	13.55		Do.
Do	0.35	230.07	13.20		Do.
Eight-mile Creek	5.41	235.48	7.79		Do.
Lake Annie	3.12	238.60	4.67		
Camp Bidwell	4.67	243.27			Town and post; two co nies.

Distances are by estimation, meander with odometer, and popular values.

The Dalles to Old Camp Watson, Oreg.—Atlas-sheets Nos. 20 *A*, 20 *B*, *and* 20 *D*.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From The Dalles.	From Old Camp Watson.		
s	....	....	122. 40	....	
ile Creek	2. 50	2. 50	119. 90	....	Good water and grass.
le Creek	3. 00	5. 50	116. 90	....	Do.
ile Creek	2. 95	8. 45	113. 95	....	Do.
f road	1. 70	10. 15	112. 25	....	
mile Creek	2. 10	12. 25	110. 15	....	Good water and grass.
ek	1. 15	13. 40	119. 00	....	Do.
nd Spring	9. 55	22. 95	109. 45	....	Do.
ills	2. 75	25. 70	96. 70	....	
Bridge, Deschutes Post-	4. 40	30. 10	92. 30	....	Good water; feed can be bought.
ing	8. 75	38. 85	83. 55	....	
en	10. 25	49. 10	73. 30	....	Good water; feed can be bought.
ollows	8. 00	57. 10	65. 30	....	Do.
e Post-office	6. 75	63. 85	58. 55	....	Do.
f road	2. 75	66. 60	55. 80	....	Good water and grass.
	1. 05	67. 65	54. 75	....	Do.
Creek Station	6. 65	74. 30	48. 10	....	Do.
nouth of Muddy Creek	3. 70	78. 00	44. 40	....	Do.
reek	7. 50	85. 50	36. 90	....	Do.
f Cherry Creek, John Day	1. 05	86. 55	35. 85	....	Do.
anch Station	4. 75	91. 30	31. 10	....	Good water; feed can be bought.
f Bridge Creek	0. 71	92. 01	30. 39	....	
reek Post-office	5. 59	97. 60	24. 80	....	Good water; forage can be bought.
lkali Flat	5. 43	103. 03	19. 37	....	Do.
nt forks of road	4. 77	107. 80	14. 60	....	Do.
Stage Station	2. 50	110. 30	12. 10	....	Good water and grass.
in House	6. 35	116. 65	5. 75	....	Do.
's Ranch	1. 75	118. 40	4. 00	....	Do.
Watson	4. 00	122. 40	....	....	

Distances are by estimation; meander with odometer and popular values.

Camp Bidwell, Cal., to Reno, Nev.—Atlas-sheets Nos. 38 *B*, 38 *D*, 47 *B*, *and* 47 *D*.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Camp Bidwell.	From Reno.		
well	....	....	190. 42	....	Town and post; two companies.
ty	16. 32	16. 32	174. 10	....	Small town.
lle	8. 65	24. 97	165. 45	....	Do.
lle	15. 90	40. 87	149. 55	....	Post-office on Eagle Creek.
anch	11. 72	52. 59	137. 83	....	South end Surprise Valley; on Silver Creek.
f road	8. 42	61. 01	129. 41	....	Road to Yuledad and Cold Spring.
Ranch	2. 87	63. 88	126. 54	....	Good water and feed.
	16. 04	79. 92	110. 50	....	Water and grass.
Station	13. 06	92. 98	97. 44	....	Do.

From Camp Bidwell, Cal., to Reno, Nev., &c.—Continued.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Camp Bidwell.	From Reno.		
Buffalo Salt Works (Murphy's)	14.73	107.71	82.71	....	Very bad water; Hole 22.94 miles.
Sheep Head	7.56	115.27	75.15	....	Good water; forag bought.
Fish Spring	27.55	142.82	47.60	....	Do.
Newcomb's Ranch	9.98	152.80	37.62	....	Do.
Giles' and Bickford's Ranch	2.15	154.95	37.47	....	Good water.
Winter's Ranch	0.80	155.75	34.67	....	Good water and gra
Yule Frank's	1.57	157.32	33.10	....	Good water; forag bought.
Chapman's	0.70	158.02	32.40	....	Do.
Warm Spring	8.68	166.70	23.72	....	Good water and gr head of Winnem ley.
Junction House	6.03	172.73	17.69	....	Good water; forag bought.
Deep Wells	4.92	177.65	12.72	....	Do.
Forks of road near Quartz Mill	10.84	188.49	1.93	....	North edge Truck ows.
Reno	1.93	190.42	....	....	Town; station C. and T. Railroads.

NOTE.—The distance from Deep Wells to Reno here given is via the new road. By the road generally the distance is 2.63 miles greater.

LISTS OF DISTANCES BETWEEN IMPORTANT POINTS ON ROADS MEANDERED BY NOS. 1 AND 2, CALIFORNIA SECTION, DURING FIELD-SEASONS 1878–'79.

Chinese Camp to Yosemite Valley, via Big Oak Flat road.
Oakdale to Snelling.
Snelling to Merced.
Snelling to Yosemite Valley, via Coulterville road.
Merced to Mariposa, Cal.
Mariposa to Yosemite Valley, via Mariposa road.
Barnard's Hotel to various points in the Yosemite.
Bower Cave to Black's and Hennessy's Bridge.
Hites' Cove to Yosemite Valley.
Fresno Flat to Clark's (via the Madera road).
Fresno Flat to Crane Valley.
Snelling, Cal., to Lagrange and Thompson's Ferry.
Lagrange to Merced Falls and Cunningham's Ranch, on old Fort Miller road
Mariposa, Cal., to Lewis' Ranch, Cal., via Moore Hill road.
Mariposa, Cal., to Bear Valley, Cal.
Hornitos to Merced via Indian Gulch and old Fort Miller road.
Hornitos to Bear Valley.
Hornitos to Redman's Ranch, Cathey's Valley, Cal.
Cathey's Valley, Cal., to Merced, Cal.
Thompson's Ferry to Crimea House.
Knight's Ferry Bridge to Chinese Camp.
Knight's Ferry Bridge to Byrnes's Ferry and Copperopolis.
Roberts's Ferry to Knight's Ferry Bridge.
New York Tent to Sonora, Cal.
Sonora to Jacksonville, Cal.
Bridgeport, Cal., to Mountain House, Cal., via cañon West Walker and Col
Bridgeport, Cal., to Mountain House, via East Walker River road.
Sonora, Cal., to San Andreas, Cal.
Sonora, Cal., to Milton, Cal.
Sonora, Cal., to Northrup's, Cal., on Sonora and Mono road.
Northrup's, Cal., to Bridgeport, Cal., via Sonora and Mono road.
Carson, Nev., to Volcano, Cal., via Amador and Nevada wagon-road.

Carson, Nev., to Murphy's, Cal., via Silver Mountain and Big Tree road.
Calaveras Grove to Murphy's, Cal.
Murphy's, Cal., to Sonora, Cal.
West Point, Cal., to Calaveras Grove.
Antelope Springs to Volcano, via Antelope and Pine Grove Turnpike.
Hite's Cove to Mariposa road.

From Chinese Camp, via Big Oak Flat Road, to Yosemite Valley, Cal.—Atlas-sheet No. 56 D.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Chinese camp.	From Yosemite.		
Chinese Camp Post-office	....	....	62.45	....	Mining town.
Null's Ranch	1.47	1.47	60.98	1,299	
Jacksonville	2.71	4.18	58.27	602	Mining town on Tuolumne, near mouth of Wood's Cr'k.
Fruit Ranch	1.03	5.21	57.24	....	Keith's orchard and vineyard.
Stevens Bar Ferry	1.24	6.45	56.00	614	Over Tuolumne River.
Culbertson's	3.45	9.90	52.55	980	Moccasin Vineyard on Moccasin Creek.
Priest's Hotel	2.21	12.11	50.34	2,558	Stage station.
Big Oak Flat	1.07	13.18	49.27	2,823	Mining town.
Groveland	2.24	15.42	47.03	2,828	Formerly 1st Garrotta.
Brewery	0.82	16.24	46.21	2,838	
2d Garrotta	1.33	17.57	44.88	2,857	Mining village.
Divide	1.33	18.90	43.55	3,136	
Sprague's Ranch	3.64	22.54	39.91	2,950	
Gravel Range	2.96	25.50	36.95	2,987	Hydraulic mines.
Big Flume	1.62	27.12	35.33	2,982	
Colfax	1.95	29.07	33.38	3,022	Toll-gate.
Crossing South Fork Tuolumne	0.93	30.00	32.45	2,654	Bridge.
Hardin's	4.39	34.39	28.06	3,396	Large ranch.
Crossing South Fork Tuolumne	1.37	35.76	26.69	....	Bridge.
Hodgdon's	5.34	41.10	21.35	4,506	Bronson's meadow; stage station; wood, water, and forage; Hazel Green by trail, 2.88 miles.
Tuolumne Grove	4.44	45.54	16.91	5,794	Opposite the Dead Giant or Tunnel Tree.
Crane Flat	1.00	46.54	15.91	6,054	Public house. To Hazel Green by road, 4.76 miles.
Tamarack Flat	5.07	51.61	10.84	6,234	Wood and water; grass scarce.
Gentry's (deserted)	2.81	54.42	8.03	5,627	Old public house.
Junction Big Oak Flat and Coulterville roads.	4.37	58.79	3.66	....	Yosemite Valley.
Bernard's Hotel	3.66	62.45	....	3,851	Yosemite post-office.

From Oakdale to Snelling, Cal.—Atlas-sheet No. 56 D.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Oakdale.	From Snelling.		
Oakdale	....	....	31.46	149	Terminus South B and C. R. R.
Fork road	2.23	2.23	29.23	215	
Martin's Ranch on Dry Creek	7.38	9.61	21.85	127	
Junction with river road near Roberts's Ferry.	6.00	15.61	15.85	234	
Roberts' Ferry	1.14	16.75	14.71	184	Tuolumne River.
Blodgett's Ranch	3.81	20.56	10.90	216	Old Morley Ranch and forage.
Fork road to Lagrange	0.56	21.12	10.34	227	Guide-board.
Cross-roads	3.51	24.63	6.83	....	
Fork roads	2.50	27.13	4.33	....	
Snelling Post-office	4.33	31.46	....	252	On Merced River.

From Snelling to Merced, via Cox's Ferry, Cal.—Atlas-sheet No. 56 D.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Snelling.	From Merced.		
Snelling	....	....	18.95	252	At post-office, fo county-seat.
Fork road to Ferry	4.29	4.29	14.66	....	Right-hand fork ru river to Hopeton,
Cox's Ferry	1.70	5.99	12.96	250	Merced River.
Cross-roads	0.43	6.42	12.53	....	Cross-road running south side Merced
Top of hill	1.67	8.09	10.86	394	
Half-way House, or Waterloo Hotel	4.51	12.60	6.35	215	
Merced (at railroad crossing)	6.35	18.95	....	171	Seat Merced County

om Snelling to Yosemite, Cal., via Coulterville Road.—Atlas-sheet No. 56 *D.*

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Snelling.	From Yosemite.		
ost-office			74. 71	252	On Merced River, formerly seat of Merced County.
d to Merced Falls	0. 61	0. 61	74. 10		
d to Lagrange	0. 65	1. 26	73. 45		
idge	3. 32	4. 58	70. 13		
ridge	0. 76	5. 34	69. 37	267	Dry Creek.
Merced Falls and La- road.	3. 79	9. 13	65. 58	477	
Station	1. 26	10. 39	64. 32	578	
road from Lagrange	3. 02	13. 41	61. 30	916	
	2. 51	15. 92	58. 79		At junction of road from Merced Falls.
dge	1. 88	17. 80	56. 91	993	On North Piney Creek.
road from Don Pedro's	1. 25	19. 05	55. 66		
Spring	0. 88	19. 93	54. 78	1, 435	Stage station.
s Ranch	1. 73	21. 66	53. 05	1, 621	Blacksmith shop.
	2. 93	24. 59	50. 12	1, 807	
ille	2. 64	27. 23	47. 48	1, 665	
ouse, near Dexter's	6. 00	33. 23	41. 48	3, 103	Junction of road from Boneyard Ranch.
	1. 58	34. 81	39. 90	2, 959	
mith Creek	1. 75	36. 56	38. 15	2, 859	
rk of North Fork Merced.	0. 78	37. 34	37. 37	2, 696	
ave	2. 16	39. 50	35. 21	2, 360	Public house on North Fork Merced.
ation	3. 23	42. 73	31. 98	3, 218	
g Trough	4. 00	46. 73	27. 98		
Deer Flat turns off	0. 58	47. 31	27. 40	4, 895	
reen	4. 93	52. 24	22. 47	5, 550	
ad to Crane Flat	0. 36	52. 60	22. 19	5, 502	By left-hand road Hazel Green to Crane Flat, 4.76 miles.
Grove Big Trees	2. 80	55. 40	19. 31		
dows	8. 45	63. 85	10. 86	4, 237	Saw-mill and toll-gate.
Trail from Hite's Cove	4. 59	68. 44	6. 27	3, 352	
oulterville and Big Oak ads.	2. 61	71. 05	3. 66		Yosemite Valley.
Hotel	3. 66	74. 71		3, 851	Yosemite post-office.
g the left-hand road at we have the following dis-					
Ranch	2. 11			2, 450	Myers's store.
of Bean Creek	2. 08			3, 333	
se	4. 09			3, 103	At junction with Coulterville stage-road, near Dexter's.
l	8. 28				Haigh's to junction with Coulterville road.

From Merced, Cal., to Mariposa, Cal.—Atlas-sheets Nos. 56 *D and* 64 *B.*

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Merced.	From Mariposa.		
Merced	....	....	40.86	171	Seat of Merced Count
Bear Creek Bridge	1.16	1.16	39.70	168	
Half-way House	5.19	6.35	34.51	215	Public house; grass i summer; water; no
Road forks to Snelling	0.87	7.22	33.64	....	
Lava Bed Station	7.26	14.48	26.38	446	
Griffith's Ranch	3.63	18.11	22.75	473	
Hornitos	4.35	22.46	18.40	847	Mining village.
Road forks to Indian Gulch	1.52	23.98	16.88	898	
Smith's Ranch	2.44	26.42	14.44	1,047	
Elkhorn Ranch	0.50	26.92	13.94	1,049	
Corbett's Ranch	1.41	28.33	12.53	1,075	Road forks to Cathey ley, 300 yards beyond
Toll-House	1.81	30.14	10.72	1,598	
Toll-House	2.83	32.97	7.89	1,780	
Summit	1.92	34.89	5.97	2,169	
Princeton	0.73	35.62	5.24	2,104	Mining village.
Foran's Store	1.19	36.81	4.05	2,173	
Summit	1.16	37.97	2.89	2,416	
Lewis' Ranch	1.19	39.16	1.70	2,112	
Sweetwater Road	0.99	40.15	0.71	1,986	
Mariposa	0.36	40.51	0.35	1,971	At Town Hall.
Do	0.35	40.86	....	1,942	At post-office.

From Mariposa, Cal., to Yosemite Valley, Cal.—Atlas-sheet No. 56 *D.*

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Mariposa.	From Yosemite Valley.		
Mariposa	....	....	53.09	1,942	Seat of Mariposa Cou
Mormon Bar	1.89	1.89	51.20	1,630	Mining village.
Sevastopol Flat	2.76	4.65	48.44	2,210	
Boot-jack Ranch	0.90	5.55	47.54	2,107	Road to Hite's Co yards beyond.
Thompson's	2.61	8.16	44.93	2,114	
Frye's	0.64	8.80	44.29	2,281	
Hale's	2.18	10.98	42.11	2,739	
Turner's (formerly Delong)	1.11	12.09	41.00	2,741	
Cold Spring	4.36	16.45	36.64	3,126	Stage station; wood, and forage.
Summit	5.24	21.69	31.40	5,605	Divide between Cho and South Fork Me
By Creek Bridge	2.43	24.12	28.97	4,430	
Clark's	2.07	26.19	26.90	3,925	Hotel and stage s wood, water, pastur forage.
Eleven-mile Station	10.76	36.95	16.14	5,567	Wood and water.
Opposite Lower Bridge	12.51	49.46	3.63	3,843	New iron bridge over
Barnard's Hotel	3.63	53.09	....	3,851	Formerly Hutchings semite post-office.

Barnard's Hotel to various points in the Yosemite Valley, Cal.—Atlas-sheet No. 56 D.

BARNARD TO SNOW'S HOTEL.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Barnard's.	From Snow's.		
·d's			4.64	3,851	At south end new bridge.
·nette Fork	2.63	2.63	2.01		Bridge.
ster Rock	0.62	3.25	1.39		Trail to foot of Vernal Fall.
Hotel	1.39	4.64		5,217	Near foot of Nevada Fall.

BARNARD'S TO LOWER BRIDGE.

rd's				3,851	Via south bank Merced River.
k's	0.77	0.77			
lig's	0.30	1.07			
Bridge	2.56	3.63		3,843	

BARNARD'S TO FORKS COULTERVILLE AND OAK FLAT ROADS.

rd's					Via north side Merced River.
ks Coulterville and Big Oak lat road.	3.82				

BARNARD'S TO FORKS COULTERVILLE AND OAK FLAT ROADS.

ırd's			3.66	3,851	Via Leidig's and Middle Bridge.
lig's	1.07	1.07			
Coulterville and Big Oak t road.	2.59	3.66			

BARNARD'S TO MIRROR LAKE.

ırd's				3.851	
ror Lake	2.62			4,025	

BARNARD'S TO EAGLE POINT.

ırd's				3,851	
umbia Rock	1.98	1.98			
t Yosemite Falls	0.69	2.67			
k of Trails	1.21	3.88			Right hand trail to top of Yosemite Falls.
le Meadows	1.36	5.24			
Point	0.90	6.14			

BARNARD'S TO GLACIER POINT.

ırd's			4.45		
ck's	0.77	0.77	3.68		
il turns off	0.27	1.04	3.41		
on Point	2.09	3.13	1.32		
er Point	1.32	4.45			

From Barnard's Hotel to various points in the Yosemite Valley, California, &c.—Conti

BARNARD'S TO SODA SPRINGS AND MOUNT LYELL VIA CATHEDRAL MEAD

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	Barnard's.	Snow's.		
Barnard's				3,661	
Register Rock	3.25	3.25			
Snow's	1.39	4.64		5,217	
Forks Trail	0.92	5.56			Trail to right, crosses by bridge and runs tinel Dome.
Fork Cloud Rest Trail	3.52	9.08			Cloud's Rest, by le trail, about 2½ miles
Top of Hill	3.23	12.31		9,499	
Divide Head of Cathedral Meadow	5.20	17.51			Near Cathedral Lake.
Junction with Lake Tenaiya Trail	4.14	21.65		8,575	Soda Springs, ⅛ mile on north bank.
Opposite junction Mount Lyell and Mount Dana Creeks.	1.60	23.25			The old Mariposa an trail runs up Mou Creek.
Head of Tuolumne Meadows	9.31	32.56		8,949	Mount Lyell, about via east side Lyell Good camping gr first lake.

From Bower Cave, Cal., to Black's and Hennessy's Bridge, Cal.—Atlas-sheet No. 5

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Bower Cave.	From Hennessy's.		
Bower Cave			21.53	2,360	Station on Coulterv Yosemite road.
Divide between North Fork Merced and Bull Creek.	2.47	2.47	19.06	3,157	
Black's	1.91	4.38	17.15	2,621	Ranch; wood, wate forage.
Divide between Bonell Gulch and Merced Fork.	3.62	8.00	13.53	3,342	End of wagon-road.
Strike Merced	3.17	11.17	10.36	1,197.1	Trail follows up c Merced, 40 feet abov
Junction South Fork and Merced	3.19	14.36	7.17	1,401	Opposite mouth of Fork, 50 feet above
Ferguson's Mill	1.64	16.00	5.53	1,389	30 feet above wate mated.
Hennessy's Bridge	5.53	21.53		1,821	Over South Fork. Hit by trail, 7.24 miles.

From Bower Cave to Black's, and the divide between Bonell Gulch and Merced the rou wagon-road; thence to Hennessy's by trail.

From Hite's Cove, Cal., to Yosemite Valley, Cal.—Atlas-sheet No. 56 D.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Hite's Cove.	From Barnard's.		
....	......	......	22.17	1,601	Mining village.
tween South Fork and	1.59	1.59	20.58	3,342	No camping place.
's Bridge	5.65	7.24	14.93	1,821	Merced River; wood and grass.
River	1.03	8.27	13.90	1,823	Wood and grass.
lle road	5.65	13.92	8.25	3,352.4	
reek	0.58	14.50	7.67	....	Wood, water, and grass.
Coulterville and Big Oak ds.	4.01	18.51	3.66	....	Yosemite Valley.
otel	3.66	22.17	....	3,851	Yosemite post-office.

trail until the Coulterville road is reached.

m *Fresno Flat, Cal., to Clark's (by new road), Cal.—Atlas-sheet No. 56 D.*

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Fresno Flat.	From Clark's.		
....	......	......	23.39	2,192	Station at post-office Mining Village.
nch	12.99	12.99	10.40	4,639	Stage station.
....	3.60	16.59	6.80	5,109	Divide between Fresno and Big Creeks.
to Big Trees	3.33	19.92	3.47	5,062	
....	3.05	22.97	0.42	5,278	With the Mariposa road.
....	0.42	23.39	....	3,925	Big Tree Station post-office.

portion of the new route from Madera, on the Southern Pacific Railroad, to the Yosemite
Clark's. It has a very easy grade.

Fresno Flat, Cal., to Crane Valley, Cal.—Atlas-sheets Nos. 56 D and 64 B.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Fresno Flat.	From Crane Valley.		
Post-office	......	......	7.91	2,192	Mining village on Fresno River.
anch	1.47	1.47	6.44	....	
....	3.95	5.42	2.49	3,504	Between Fresno River and North Fork San Joaquin.
....	0.66	6.08	1.83	....	Road forks to left to saw-mill.
y	1.83	7.91	....	3,185	Bridge near Sharpton's Ranch, on North Fork San Joaquin.

n Fresno Flat a road runs up the Fresno to the Madera saw-mill; distance 8.05 miles.

From Merced, Cal., to Mariposa, Cal.—Atlas-sheets Nos. 56 D and 64 B.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Merced.	From Mariposa.		
Merced	....	....	40.86	171	Seat of Merced Co
Bear Creek Bridge	1.16	1.16	39.70	168	
Half-way House	5.19	6.35	34.51	215	Public house; gra summer; water;
Road forks to Snelling	0.87	7.22	33.64	....	
Lava Bed Station	7.26	14.48	26.38	446	
Griffith's Ranch	3.63	18.11	22.75	473	
Hornitos	4.35	22.46	18.40	847	Mining village.
Road forks to Indian Gulch	1.52	23.98	16.88	898	
Smith's Ranch	2.44	26.42	14.44	1,047	
Elkhorn Ranch	0.50	26.92	13.94	1,049	
Corbett's Ranch	1.41	28.33	12.53	1,075	Road forks to Catl ley, 300 yards bey
Toll-House	1.81	30.14	10.72	1,598	
Toll-House	2.83	32.97	7.89	1,780	
Summit	1.92	34.89	5.97	2,169	
Princeton	0.73	35.62	5.24	2,104	Mining village.
Foran's Store	1.19	36.81	4.05	2,173	
Summit	1.16	37.97	2.89	2,416	
Lewis' Ranch	1.19	39.16	1.70	2,112	
Sweetwater Road	0.99	40.15	0.71	1,986	
Mariposa	0.36	40.51	0.35	1,971	At Town Hall.
Do	0.35	40.86	....	1,942	At post-office.

From Mariposa, Cal., to Yosemite Valley, Cal.—Atlas-sheet No. 56 D.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Mariposa.	From Yosemite Valley.		
Mariposa	....	....	53.09	1,942	Seat of Mariposa C
Mormon Bar	1.89	1.89	51.20	1,630	Mining village.
Sevastopol Flat	2.76	4.65	48.44	2,210	
Boot-jack Ranch	0.90	5.55	47.54	2,107	Road to Hite's yards beyond.
Thompson's	2.61	8.16	44.93	2,114	
Frye's	0.64	8.80	44.29	2,281	
Hale's	2.18	10.98	42.11	2,739	
Turner's (formerly Delong)	1.11	12.09	41.00	2,741	
Cold Spring	4.36	16.45	36.64	3,126	Stage station; wo and forage.
Summit	5.24	21.69	31.40	5,605	Divide between C and South Fork
By Creek Bridge	2.43	24.12	28.97	4,430	
Clark's	2.07	26.19	26.90	3,925	Hotel and stage wood, water, past forage.
Eleven-mile Station	10.76	36.95	16.14	5,567	Wood and water.
Opposite Lower Bridge	12.51	49.46	3.63	3,843	New iron bridge ove
Barnard's Hotel	3.63	53.09	....	3,851	Formerly Hutchin semite post-office.

rnard's Hotel to various points in the Yosemite Valley, Cal.—Atlas-sheet No. 56 D.

BARNARD TO SNOW'S HOTEL.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Barnard's.	From Snow's.		
s			4. 64	3, 851	At south end new bridge.
tte Fork	2. 63	2. 63	2. 01		Bridge.
r Rock	0. 62	3. 25	1. 39		Trail to foot of Vernal Fall.
otel	1. 39	4. 64		5, 217	Near foot of Nevada Fall.

BARNARD'S TO LOWER BRIDGE.

s				3, 851	**Via south bank Merced River.**
	0. 77	0. 77			
s	0. 30	1. 07			
idge	2. 56	3. 63		3, 843	

BARNARD'S TO FORKS COULTERVILLE AND OAK FLAT ROADS.

s					**Via north side Merced River.**
Coulterville and Big Oak road.	3. 82				

BARNARD'S TO FORKS COULTERVILLE AND OAK FLAT ROADS.

s			3. 66	3, 851	**Via Leidig's and Middle Bridge.**
s	1. 07	1. 07			
oulterville and Big Oak ad.	2. 59	3. 66			

BARNARD'S TO MIRROR LAKE.

s				3. 851	
Lake	2. 62			4, 025	

BARNARD'S TO EAGLE POINT.

s				3, 851	
bia Rock	1. 98	1. 98			
osemite Falls	0. 69	2. 67			
f Trails	1. 21	3. 88			**Right hand trail to top of Yosemite Falls.**
Meadows	1. 36	5. 24			
int	0. 90	6. 14			

BARNARD'S TO GLACIER POINT.

s			4. 45		
s	0. 77	0. 77	3. 68		
urns off	0. 27	1. 04	3. 41		
Point	2. 09	3. 13	1. 32		
Point	1. 32	4. 45			

From Barnard's Hotel to various points in the Yosemite Valley, California, &c.—Cont

BARNARD'S TO SODA SPRINGS AND MOUNT LYELL VIA CATHEDRAL MEAD

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	Barnard's.	Snow's.		
Barnard's	....	....	....	3, 851	
Register Rock	3. 25	3. 25	....	....	
Snow's	1. 39	4. 64	....	5, 217	
Forks Trail	0. 92	5. 56	....	....	Trail to right, crosses by bridge and runs tinel Dome.
Fork Cloud Rest Trail	3. 52	9. 08	....	....	Cloud's Rest, by le trail, about 2¼ mile
Top of Hill	3. 23	12. 31	....	9, 499	
Divide Head of Cathedral Meadow	5. 20	17. 51	....	....	Near Cathedral Lake
Junction with Lake Tenaiya Trail	4. 14	21. 65	....	8, 575	Soda Springs, $\frac{3}{10}$ mile on north bank.
Opposite junction Mount Lyell and Mount Dana Creeks.	1. 60	23. 25	....	....	The old Mariposa an trail runs up Mou Creek.
Head of Tuolumne Meadows	9. 31	32. 56	....	8, 949	Mount Lyell, about via east side Lyell Good camping gr first lake.

From Bower Cave, Cal., to Black's and Hennessy's Bridge, Cal.—Atlas-sheet No. 5

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Bower Cave.	From Hennessy's.		
Bower Cave	....	....	21. 53	2, 360	Station on Coulterv Yosemite road.
Divide between North Fork Merced and Bull Creek.	2. 47	2. 47	19. 06	3, 157	
Black's	1. 91	4. 38	17. 15	2, 621	Ranch; wood, wat forage.
Divide between Bonell Gulch and Merced Fork.	3. 62	8. 00	13. 53	3, 342	End of wagon-road.
Strike Merced	3. 17	11. 17	10. 36	1, 197. 1	Trail follows up c Merced, 40 feet abo
Junction South Fork and Merced	3. 19	14. 36	7. 17	1, 401	Opposite mouth of Fork, 50 feet above
Ferguson's Mill	1. 64	16. 00	5. 53	1, 389	30 feet above wat mated.
Hennessy's Bridge	5. 53	21. 53	....	1, 821	Over South Fork; Hi by trail, 7.24 miles.

From Bower Cave to Black's, and the divide between Bonell Gulch and Merced the rou wagon-road; thence to Hennessy's by trail.

From Hite's Cove, Cal., to Yosemite Valley, Cal.—Atlas-sheet No. 56 *D.*

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Hite's Cove.	From Barnard's.		
s........................	....	....	22. 17	1, 601	Mining village.
etween South Fork and l.	1. 59	1. 59	20. 58	3, 342	No camping place.
y's Bridge...............	5. 65	7. 24	14. 93	1, 821	Merced River; wood and grass.
River....................	1. 03	8. 27	13. 90	1, 823	Wood and grass.
ille road................	5. 65	13. 92	8. 25	3, 352. 4	
Creek....................	0. 58	14. 50	7. 67	....	Wood, water, and grass.
Coulterville and Big Oak ads.	4. 01	18. 51	3. 66	....	Yosemite Valley.
Hotel....................	3. 66	22. 17	....	3, 851	Yosemite post-office.

' trail until the Coulterville road is reached.

om Fresno Flat, Cal., to Clark's (by new road), Cal.—Atlas-sheet No. 56 *D.*

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Fresno Flat.	From Clark's.		
t........................	....	....	23. 39	2, 192	Station at post-office Mining Village.
anch.....................	12. 99	12. 99	10. 40	4, 639	Stage station.
....	3. 60	16. 59	6. 80	5, 109	Divide between Fresno and Big Creeks.
d to Big Trees...........	3. 33	19. 92	3. 47	5, 062	
....	3. 05	22. 97	0. 42	5, 278	With the Mariposa road.
....	0. 42	23. 39	....	3, 925	Big Tree Station post-office.

portion of the new route from Madera, on the Southern Pacific Railroad, to the Yosemite Clark's. It has a very easy grade.

ı Fresno Flat, Cal., to Crane Valley, Cal.—Atlas-sheets Nos. 56 *D and* 64 *B.*

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Fresno Flat.	From Crane Valley.		
at Post-office...........	....	....	7. 91	2, 192	Mining village on Fresno River.
Ranch....................	1. 47	1. 47	6. 44	....	
....	3. 95	5. 42	2. 49	3, 504	Between Fresno River and North Fork San Joaquin.
....	0. 66	6. 08	1. 83	....	Road forks to left to saw-mill.
ey.......................	1. 83	7. 91	....	3, 185	Bridge near Sharpton's Ranch, on North Fork San Joaquin.

om Fresno Flat a road runs up the Fresno to the Madera saw-mill; distance 8.05 miles.

From Knight's Ferry Bridge to Copperopolis, Cal., via Byrnes's Ferry.—Atlas-shee 56 C and 56 D.

	Distance in miles.			Altitude in feet above sea-level.	
	Between consecutive points.	From Knight's Ferry Bridge.	From Copperopolis.		
Knight's Ferry Bridge	......	....	25. 91	180	On Stanislaus, above t Knight's Ferry.
Buena Vista	0. 33	. 33	25. 58	323	Store.
Ranch and spring	2. 92	3. 25	22. 66	....	
Crabtrees	1. 54	4. 79	26. 12	934	
Divide	1. 00	5. 79	21. 12	1, 117	
Fork roads	2. 04	7. 83	18. 08	....	Lagrange road, to right
Keystone House	1. 11	8. 94	16. 97	1, 093	Public house cross-roa
New York Tent	4. 05	12. 99	12. 92	1, 143	Cross-road.
Fork road to Sonora	0. 46	13. 45	12 46	1, 117	Via Rawhide Camp.
Byrnes's Ferry	4. 86	18. 31	7. 60	380	Toll-bridge over Stani
School-House	2. 57	20. 88	5. 03	412	
Copperopolis Post Office	5. 03	25. 91	....	1, 015	Old mining town.

From Roberts' Ferry to Knight's Ferry Bridge, Cal.—Atlas-sheets Nos. 56 C and 56

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Roberts' Ferry.	From Knight's Ferry Bridge.		
Roberts' Ferry	......	......	24. 09	184	Tuolumne River.
Fork of roads	0. 70	. 70	23. 39	223	
Large Ranch	5. 66	6. 36	17. 73	230	
Junction Lagrange and Knight's Ferry Bridge.	1. 76	8. 12	15 97	251	
Divide between Tuolumne and Stanislaus.	4. 58	12. 70	11. 39	518	
Williams' Ranch	1. 24	13. 94	10. 15	345	
Buena Vista	1. 54	15. 48	8. 61	323	Flagstaff at store.
Knight's Ferry Bridge	0. 33	15. 81	....	180	Over Stanislaus, Knight's Ferry.

From New York Tent to Sonora, Cal.—Atlas-sheet No. 56 D.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From New York Tent.	From Sonora.		
New York Tent	....	......	9. 45	143	Cross-roads.
Fork road to Byrnes' Ferry	0. 46	. 40	8. 99	1, 117	
Table Mountain Divide	0. 42	. 88	8. 57	1, 198	
Ranch and creek	1. 31	2. 19	7. 26	113	
Divide between creeks	0. 96	3. 15	6. 30	1, 320	
Rawhide Camp	4. 00	7. 15	2. 30	1, 556	At store.
Fork road to Tuttletown	2. 30	9. 45	....	1, 566	
Shaw's Flat	3. 22	....	....	2, 036	
Sonora Post Office	2. 18	....	....	1, 816	

riposa, Cal., to Lewis Ranch, Cal., via Moore Hill Road, Atlas-sheet No. 56 *D.*

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Mariposa.	From Lewis Ranch.		
st-office			15. 31	1, 932	Mining town; seat of Mariposa County.
ar	1. 89	1. 89	13. 42	1, 630	Mining village.
	4. 20	6. 09	9. 22	1, 357	Old mining village.
	1. 00	7. 09	8. 22	1, 588	Moore Hill.
reek Crossing	1. 55	8. 64	6. 67	1, 142	
	6. 67	15. 31		966	Wood, water, forage or pasturage.

From Mariposa, Cal., to Bear Valley, Cal., Atlas-sheet No. 56 *D.*

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Mariposa.	From Bear Valley.		
st-office			11. 80	1, 932	Seat of Mariposa County.
	5. 24	5. 24	6. 56	2, 104	Mining village.
e right-hand)	0. 36	5. 60	6. 20		Left-hand road to Hornitos, 12.10 miles.
Post-office	6. 20	11. 80		2, 087	Mining village.

itos to Merced, Cal., via Indian Gulch and Old Fort Miller road.—Atlas-sheet No. 56 *D.*

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Hornitos.	From Merced.		
			30. 67		Mining village.
iposa road	1. 52	1. 52	29. 15	898	Mariposa road forks to left.
n Mariposa road	1. 64	3. 16	27. 51	1, 058	
they Valley	2. 27	5. 43	25. 24		
ch	0. 27	5. 70	24. 97	951. 4	Mining village.
iller road	5. 56	11. 26	19. 41		
ch	0. 36	11. 62	19. 05	307	Wood, water, and grass.
Crossing	1. 94	13. 56	17. 11	350	
l Cathey's Valley road	1. 26	14. 82	15. 85	373	Old Fort Miller road crosses Cathey's Valley and Merced road.
spital	11. 97	26. 79	3. 88		
ilroad crossing)	3. 88	30. 67		171	Seat Merced County.

From Hornitos to Bear Valley, Cal.—Atlas-sheet No. 56 D.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Hornitos.	From Bear Valley.		
Hornitos Hotel	....	....	10. 79	847	Mining village.
Washington Quartz Mills	2. 48	2. 48	8. 31	1, 032	
Fork Road to Simmons's Ranch	2. 90	5. 38	5. 41	1, 387	
* Blackmore's Ranch	1. 85	7. 23	3. 56	2, 230	Road forks to left to er's Valley and ran
Divide	1. 52	8. 75	2. 04	2, 755	Between Hunter's and Bear Valley.
Bear Valley	2. 04	10. 79	....	2, 087	At Oso House.

* Road to left runs to ranches on Cotton Creek, Hunter's Valley, and to old mining village of Cl (deserted), distant 3.95 miles.

From Hornitos to Redman's Ranch, Cathey's Valley, Cal.—Atlas-sheet No. 56

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Hornitos.	From Redman's Ranch.		
Hornitos Hotel	....	....	12. 82	847	Mining town.
Corbett's Ranch	5. 87	5. 87	6. 95	1, 075	Forks Cathey's Vall Mariposa roads, 30 beyond.
Fitzhugh's Ranch	3. 77	9. 64	3. 18	1, 162	Do.
Church and school-house	0. 97	10. 61	2. 21	1, 252	Valley.
Cathey's Ranch	1. 33	11. 94	. 88	1, 260	Wood, water, and fora
Redman's Ranch	0. 88	12. 82	....	1, 181	Do.

From Cathey's Valley to Merced, Cal.—Atlas-sheet No. 56 D.

	Distance in miles.			Altitude in feet above sea-level.	Remarks
	Between consecutive points.	From Cathey's.	From Merced.		
Redman's	....	....	25. 53	1, 180	Wood, water, and for
Crossing Millerton road	9. 68	9. 68	15. 85	313	
School-House	10. 28	19. 96	5. 57	182	
Upton's	1. 03	20. 99	4. 54	....	Water and forage.
County Hospital	0. 66	21. 65	3. 38	....	
Taylor's	1. 02	22. 67	2. 86	....	Do.
Bear Creek Bridge	1. 69	24. 36	1. 17	168	
Merced (at railroad crossing)	1. 17	25. 53	....	171	Seat of Merced Co Southern Pacific R

From Thompson's Ferry to Crimea House, Cal.—Atlas-sheet No. 56 *D.*

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Thompson's Ferry.	From Crimea House.		
Thompson's Ferry	....	....	18.41	188	— miles below Lagrange, on Tuolumne River; wood, water, and grass.
Junction old Lagrange and Knight's Ferry road.	5.17	5.17	13.24	319	
Bosang's road on Dry Creek	0.71	5.88	12.53	....	
Gallup's road	0.90	6.78	11.63	280	
Junction Lagrange freight road	1.40	8.18	10.23	259	At Stone Fence, ½ mile north of Armstrong's Ranch; main road keeps on to Knight's Ferry; right-hand road to Crimea House.
Drew's Ranch	6.20	14.38	4.03	1,090	
Divide	0.63	15.01	3.40	1,384	
Crimea House	3.40	18.41	....	1,221	Public house; wood, water, and forage.

This route is by the first road to right below Thompson's Ferry. Between the river and the old Lagrange and Knight's Ferry road the road is at present a natural grade, only suitable for light wagons. Freight teams take the next right-hand road, and strike the Lagrange and Knight's Ferry road 0.5 mile beyond Armstrong's Ranch.

From Knight's Ferry Bridge to Chinese Camp, Cal.—Atlas-sheet No. 56 *B and D.*

	Distance in miles.			Altitude in feet above sea-level.	
	Between consecutive points.	From Knight's Ferry Bridge.	From Chinese Camp.		
Knight's Ferry Bridge	....	....	14.75	180	Over Stanislaus, above Knight's Ferry.
Crabtrees	4.79	4.79	9.96	934	Ranch and spring.
Keystone House	4.15	8.94	5.81	1,093	Public house at cross-roads.
Crimea House	1.69	10.63	4.12	1,221	Public house; wood, water, and forage.
Taylor's Ranch	2.73	13.36	1.39	1,047	Public house on Six-bit Gulch.
Chinese Camp Post Office	1.39	14.75	....	1,299	Mining town.

From Bridgeport, Cal., to Mountain House, Nev., via East Walker River Road.—Atlas-sheets Nos. 57 *A and* 56 *B.*

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Bridgeport.	From Mountain House.		
Bridgeport Post Office			55. 27	6, 423	Seat of Mono County, on the East Walker River; water and pasturage.
Toll-House	8. 54	8. 54	46. 73		
Frying Pan Creek	3. 48	12. 02	43. 25		
Boundary Stake	0. 96	12. 98	42. 29		California and Nevada boundary.
Carson and Aurora stage-road	2. 46	15. 44	39. 83		
Sweetwater Post Office	1. 28	16. 72	38. 55		Store.
Williams' Station	2. 83	19. 55	35. 72		Stage station; wood, water, and forage.
Ranch	6. 85	26. 40	28. 87		Cattle ranch.
Sulphur Spring Station	4. 82	31. 22	24. 05		Stage station; wood, water, and forage.
Matthews' Ranch	7. 86	39. 08	16. 19		Desert Creek, stage station; water and forage.
*Road to Wellington's	3. 75	42. 83	12. 44		Stage station on West Walker River, 0.46 miles distant.
†Hoye's Store	3. 82	46. 65	8. 62		Walker River post-office; stage station; wood, water, and forage.
Fork of road to Coleville	0. 88	47. 53	7. 74		Road forks to the left and runs up west side Antelope Valley.
Mountain House	7. 74	55. 27		5, 641	

* Wellington's is off the main road 0.46 mile. Total, Matthews' to Wellington's, 4.21 miles; Wellington's to Hoye's, 3.80 miles.

† Hoye's Store to Coleville, via wagon-road on east side Antelope Valley, is little traveled. Hoye's Store to Coleville, via west side Antelope Valley (main route), 10.38 miles.

From Sonora to San Andreas, Cal.—Atlas-sheets Nos. 56 *D and* 56 *C.*

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Sonora.	From San Andreas.		
Sonora			28. 09	1, 816	At post-office; seat of Tuolumne County.
Shaw's Flat	2. 18	2. 18	26. 01	2, 036	Mining village.
Tuttletown	4. 30	6. 48	21. 61	1, 321	Do.
Robertson's Ferry	2. 16	8. 64	19. 45	819	Stanislaus River.
Angel's	6. 57	15. 21	12. 88		Mining town.
San Andreas	12. 88	28. 09		1, 033	Seat of Calaveras County.

From Sonora to Milton, Cal.—Atlas-sheets Nos. 56 *D and* 56 *C.*

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Sonora.	From Milton.		
Sonora	....	....	34. 65	1, 816	At the post-office.
Shaw's Flat	2. 18	2. 18	32. 47	2, 036	
Illinois Ranch	2. 25	4. 43	30. 22	1, 759	Wood, water, and forage.
Tuttletown	2. 05	6. 48	28. 17	1, 321	Mining village.
Forks of road	1. 23	7. 71	26. 94	....	Robertson's Ferry, 1 mile by right-hand road.
Reynolds's Ferry	4. 39	12. 10	22. 55	543	South Fork of the Stanislaus.
Copperopolis	7. 72	19. 82	14. 83	1, 015	Mining town.
Reservoir House	8. 70	28. 52	6. 13	1, 013	Stage station; wood, water and forage.
Toll-house	1. 59	30. 11	4. 54	777	
Milton	4. 54	34. 65	....	376	At the railroad depot; terminus Stockton and Copperopolis Railroad.

Stage-route between Milton and Sonora.

From Sonora to Northrup's, Cal.—Atlas-sheet No. 56 *D.*

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Sonora.	From Northrup's.		
Sonora	....	....	14. 49	1, 816	At post-office.
McQuaid's	0. 62	. 62	13. 87	1, 888	Forage, &c.; public house; road forks to Jacksonville.
Sullivan Creek	1. 97	2. 59	11. 90	....	Ranch.
Road to Phenix Reservoirs	0. 55	3. 14	11. 35	....	Do.
School-House	1. 69	4. 83	9. 66	....	
Soulsbyville House	1. 43	6. 26	8. 23	....	Public house.
Crawford's	1. 79	8. 05	6. 44	....	Ranch.
Old Toll-house	3. 06	11. 11	3. 38	....	Do.
Baxter's	2. 13	13. 24	1. 25	4, 115	Mining camp, Confidence mine; gold, quartz.
Northrup's (Excelsior Hotel)	1. 25	14. 49	....	4, 519	Stage station and toll-house; wood, water, and forage.

This is a portion of the Sonora and Mono turnpike-road from Sonora to Bridgeport, Cal. Road kept in good order. Main stage-route between Sonora and the Bodie and Aurora mines.

From Bridgeport, Cal., to Mountain House, Nev., via East Walker River Roa sheets Nos. 57 A and 56 B.

	Distance in miles.			Altitude in feet above sea-level.	Remark
	Between consecutive points.	From Bridgeport.	From Mountain House.		
Bridgeport Post Office	....	....	55. 27	6, 423	Seat of Mono Co East Walker R and pasturage.
Toll-House	8. 54	8. 54	46. 73	....	
Frying Pan Creek	3. 48	12. 02	43. 25	....	
Boundary Stake	0. 96	12. 98	42. 29	....	California and Ne ary.
Carson and Aurora stage-road	2. 46	15. 44	39. 83	....	
Sweetwater Post Office	1. 28	16. 72	38. 55	....	Store.
Williams' Station	2. 83	19. 55	35. 72	....	Stage station; w and forage.
Ranch	6. 85	26. 40	28. 87	....	Cattle ranch.
Sulphur Spring Station	4. 82	31. 22	24. 05	....	Stage station; w and forage.
Matthews' Ranch	7. 86	39. 08	16. 19	....	Desert Creek, sta water and forag
*Road to Wellington's	3. 75	42. 83	12. 44	....	Stage station Walker River, distant.
†Hoye's Store	3. 82	46. 65	8. 62	....	Walker River stage station; w and forage.
Fork of road to Coleville	0. 88	47. 53	7. 74	....	Road forks to th runs up west lope Valley.
Mountain House	7. 74	55. 27	....	5, 641	

* Wellington's is off the main road 0.46 mile. Total, Matthews' to Wellington's, 4.21 m ington's to Hoye's, 3.80 miles.

† Hoye's Store to Coleville, via wagon-road on east side Antelope Valley, is little travel Store to Coleville, via west side Antelope Valley (main route), 10.38 miles.

From Sonora to San Andreas, Cal.—Atlas-sheets Nos. 56 *D and* 56 *C.*

	Distance in miles.			Altitude in feet above sea-level.	Remark
	Between consecutive points.	From Sonora.	From San Andreas.		
Sonora	....	....	28. 09	1, 816	At post-office; s lumne County.
Shaw's Flat	2. 18	2. 18	26. 01	2, 036	Mining village.
Tuttletown	4. 30	6. 48	21. 61	1, 321	Do.
Robertson's Ferry	2. 16	8. 64	19. 45	819	Stanislaus River.
Angel's	6. 57	15. 21	12. 88	....	Mining town.....
San Andreas	12. 88	28. 09	....	1, 033	Seat of Calaveras

From Carson, Nev., to Volcano, Cal., via Amador and Nevada wagon-road.—Atlas-sheets Nos. 47 D and 56 B.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Carson.	From Volcano.		
Carson	....	....	97.00	4,660	At the capitol.
Woodford's	30.87	30.87	66.13	5,676	Stage station; mouth of cañon of West Fork Carson River.
[*]Williams' Ranch	13.11	43.98	53.02	7,757	Wood, water, and grass.
Carson Pass	1.81	45.79	51.21	8,634	Crest of Sierra Nevada.
Caple's Ranch	3.68	49.47	47.53	7,780	Clear Lakes; wood, water, and grass.
Silver Lake Hotel	7.37	56.84	40.16	7,174	Public house; wood, water, and forage.
Tragedy Spring	3.00	59.84	37.16	7,989	Wood, water, and grass.
[†]Road forks to Pleasant Valley	4.48	64.32	32.68	....	
Corral Flat	0.78	65.10	31.90	....	Wood and water; grass scarce.
Peddler's Hill	5.66	70.76	26.24	6,831	Wood, spring (runs dry in summer).
Cold Spring	4.39	75.15	21.85	......	Wood and water.
Mud Spring	0.39	75.54	21.46	5,973	Do.
Ham's Station	2.08	77.62	19.38	5,439	Public house; wood, water, and forage.
Wiley's Station	3.77	81.39	15.61	5,027	Do.
Antelope Spring	3.20	84.59	12.41	4,272	Do.
Forks of road	0.32	84.91	12.09	....	Left fork known as Antelope and Pine Grove Turnpike.
Horsley's Station	1.34	86.25	10.75	3,800	Public house; formerly French Camp; wood, water, and forage.
Myers's Station	2.23	88.48	8.52	3,750	Public house; formerly Thorp's; wood; water, and forage.
[‡]Foster's Station	2.17	90.65	6.35	3,265	Public house; wood, water, and forage.
[§]Denser's Station	3.07	93.72	3.28	2,922	Public house; wood, water and forage.
Volcano	3.28	97.00	....	2,075	Mining town.

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[*] At Williams' Ranch there is a branch road to Hermit Valley, on the Big Tree road; distance, 16.71 miles. From this branch road a road forks to the right and runs to Summit City (abandoned) and Blue Lakes.

[†] At this point a road forks to the right, running to Leek Spring, Pleasant Valley, and Newtown. (See Report of 1878, p. 61.)

[‡] Right-hand road to Fiddletown.

[§] Right-hand road to Sutter.

From Northrup's to Bridgeport, Cal.—Atlas-sheets Nos. 56 B, 56 D, and 57 A.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Northrup's.	From Bridgeport.		
Northrup's			84. 74	4, 519	Post-office.
Bradford's Saw-Mill	4. 91	4. 91	79. 83		Trail.
Ranch	1. 84	6. 75	77. 99		Wood, water, and grass.
Bald Mountain	2. 78	9. 53	75. 21	5, 829	The altitude is at bare poi on top of ridge.
Cold Spring	2. 85	12. 38	72. 36		Good spring south of road.
Strawberry	3. 55	15. 93	68. 81	5, 238	Stage station; wood, wat and forage.
Summit	2. 27	18. 20	66. 55	6, 352	Divide between the Sou and Middle Forks of t Stanislaus.
Cow Creek	1. 90	20. 10	64. 64	5, 905	Ranch; main branch Co Creek ¼ mile beyond.
Lilly Creek	2. 17	22. 27	62. 47		
Cascade Creek	2. 62	24. 89	59. 85	6, 272	
Mill Creek	2. 58	27. 47	57. 27	6, 467	Bridge.
Niagara Creek	2. 55	30. 02	54. 72	6, 690	Do.
Eagle Creek	7. 73	37. 75	46. 99		Bridge; road crosses Stan lans 0.4 miles beyond.
Eureka Valley	2. 90	40. 65	44. 09	5, 957	Stage station (former Hay's).
Hog's Pass	3. 00	43. 65	41. 09		Road cut through grani bowlder.
Summit	8. 20	51. 85	32. 89	9, 660	Sonora Pass, crest of Sier Nevada.
Leavitt's	7. 59	59. 44	25. 30		Stage station and horse ranc
Pickle's	3. 42	62. 86	21. 88		Horse ranch.
West Walker River	1. 89	64. 75	19. 99		Bridge; wood and wate grass scarce.
East Branch West Walker	2. 40	61. 15	17. 59	7, 019	Ford; road from Colevill wood, water, and grass.
Hot Springs	3. 29	70. 44	14. 30	7, 384	Stage station; forage a pasturage.
Rickey's	7. 32	77. 76	6. 98		Hay and cattle ranch.
Saw-Mill	1. 98	79. 74	5. 00		Formerly Yaney's.
Bridgeport	5. 00	84. 74		6, 423	Seat Mono County; pastu age and forage.

Sonora and Mono stage-road, being part of the through stage-route from Milton, on Stockton a Copperopolis Railroad, to the Bodie and Aurora mining district.

From Carson, Nev., to Volcano, Cal., via Amador and Nevada wagon-road.—Atlas-sheets Nos. 47 D and 56 B.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Carson.	From Volcano.		
Carson	....	....	97.00	4,660	At the capitol.
Woodford's	30.87	30.87	66.13	5,676	Stage station; mouth of cañon of West Fork Carson River.
[*] Williams' Ranch	13.11	43.98	53.02	7,757	Wood, water, and grass.
Carson Pass	1.81	45.79	51.21	8,634	Crest of Sierra Nevada.
Caple's Ranch	3.68	49.47	47.53	7,780	Clear Lakes; wood, water, and grass.
Silver Lake Hotel	7.37	56.84	40.16	7,174	Public house; wood, water, and forage.
Tragedy Spring	3.00	59.84	37.16	7,989	Wood, water, and grass.
[†] Road forks to Pleasant Valley	4.48	64.32	32.68	....	
Corral Flat	0.78	65.10	31.90	....	Wood and water; grass scarce.
Peddler's Hill	5.66	70.76	26.24	6,831	Wood, spring (runs dry in summer).
Cold Spring	4.39	75.15	21.85	......	Wood and water.
Mud Spring	0.39	75.54	21.46	5,973	Do.
Ham's Station	2.08	77.62	19.38	5,439	Public house; wood, water. and forage.
Wiley's Station	3.77	81.39	15.61	5,027	Do.
Antelope Spring	3.20	84.59	12.41	4,272	Do.
Forks of road	0.32	84.91	12.09	....	Left fork known as Antelope and Pine Grove Turnpike.
Horsley's Station	1.34	86.25	10.75	3,860	Public house; formerly French Camp; wood, water, and forage.
Myers's Station	2.23	88.48	8.52	3,759	Public house; formerly Thorp's; wood; water, and forage.
[‡] Foster's Station	2.17	90.65	6.35	3,265	Public house; wood, water, and forage.
[§] Denser's Station	3.07	93.72	3.28	2,922	Public house; wood, water and forage.
Volcano	3.28	97.00	....	2,075	Mining town.

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[*] At Williams' Ranch there is a branch road to Hermit Valley, on the Big Tree road; distance, 16.71 miles. From this branch road a road forks to the right and runs to Summit City (abandoned) and Blue Lakes.

[†] At this point a road forks to the right, running to Leek Spring, Pleasant Valley, and Newtown. (See Report of 1878, p. 61.)

[‡] Right-hand road to Fiddletown.

[§] Right-hand road to Sutter.

From Carson, Nev., to Murphy's, Cal., via Silver Mountain City and Big Tree road.- sheets Nos. 47 D and 56 B.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Carson.	From Murphy's.		
Carson			110.37	4,660	State capitol.
Woodford's	30.87	30.87	79.50	5,676	Stage station mont west Fork Carso
Markleeville	6.63	37.50	72.87	5,525	Seat of Alpine Count
Bridge and Old Toll-house	1.61	39.11	71.26		
Mount Bullion Toll-house	3.74	42.85	67.52		Road to Monitor the west.
Centreville	2.55	45.40	64.97		Abandoned mining opposite mouth Creek.
Silver Mountain City	3.26	48.66	61.71	6,446	Mining town; wood and forage.
First Summit	6.23	54.89	55.48		Divide between basins of the Ca Mokelumne River
Hermit Valley	5.47	60.36	50.01	7,039	Wood, water, and pasturage.
Second Summit	2.71	63.07	47.30	8,157	Divide between basins of Mokelu Stanislaus Rivers.
Silver Valley	5.74	68.81	41.56		Wood, water, and g
Blood's Station	3.74	72.55	37.82	6,979	Toll-house and cattl wood, water, and or pasturage.
Onion Valley	2.33	74.88	35.49		Wood and water; gr
*Big Meadow Creek	3.01	77.89	32.48	6,464	Wood, water, and bridge.
Black Springs	5.70	83.59	26.78	6,485	Wood and water scarce.
Gardener's Station	8.54	92.13	28.24		Wood, water, and pasturage.
Big Trees of Calaveras	2.82	94.95	15.42	4,730	Hotel; wood, water, age.
Half-Way House	7.31	102.26	8.11	3,358	Inn; wood, water, age.
Murphy's mining village	8.11	110.37		2,195	Blacksmith's shop roads; post-office west.

Good mountain road.

***A little beyond this creek a road to West Point turns off. It is used principally by sh cattle herders. Distance as follows: Big Meadow Creek to Big Meadow Ranch, 1.39 mi Meadow Ranch to Folsom and Hall's, at Hunter's Flat, 16.17 miles; Folsom and Hall's to Ranch, 3.71 miles; Lillie's to West Point, 6.34 miles; total distance, 21.61 miles.**

From Calaveras Big Tree Grove to Murphy's, Cal.—Atlas-sheet No. 56 *B.*

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Calaveras Grove.	From Half-Way House.		
*Calaveras Grove	....	....	7. 60	4, 730	At the hotel.
Fourteen-mile House	1. 21	1. 21	6. 39	....	
West Point road	1. 38	2. 59	5. 01	....	Road to West Point via Railroad Flat.
Ranch	2. 16	4. 75	2. 85	....	Wood, water, and forage.
Half-Way House	2. 85	7. 60	....	3, 358	Wood, water, and forage; stage station.
†Calaveras Grove	....	....	**7. 31**	**4, 730**	**Hotel; wood, water, pasturage, and forage.**
Junction	**2. 10**	**2. 10**	**5. 21**	....	
Moran's Ranch	**1. 04**	**3. 14**	**4. 17**	**3, 984**	**Wood, water, pasturage, and forage.**
Flanders' Ranch	**1. 30**	**4. 44**	**2. 87**	....	
Half-Way House	**2. 87**	**7. 31**	....	....	**Stage station.**
Half-Way House	....	....	....	**3, 358**	
Murphy's	**8. 11**	....	....	**2, 195**	**At blacksmith's shop, fork of Altaville and Sonora roads, ½ mile northeast of post-office.**

* Via upper road. **† Via lower or Moran road. Both routes good.**

From Murphy's to Sonora, Cal.—Atlas-sheets Nos. 56 *B and* 56 *D.*

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Murphy's.	From Sonora.		
Murphy's	....	....	18. 24	2, 195	Mining village; at blacksmith shop.
Douglas Flat	1. 67	1. 67	16. 57	....	Do.
Vallecito	2. 49	4. 16	14. 08	1, 748	City post-office; mining village.
Trail to Natural Bridge	3. 32	7. 48	10. 76	....	Natural bridges on Coyote Creek; ½ mile.
Parrott's (formerly Pandola) Ferry	2. 27	9. 75	8. 49	834	South Fork Stanislaus.
Gold Spring	3. 17	12. 92	5. 32	2, 014	Old mining village; wood, water, and forage.
Columbia Post Office	1. 15	14. 07	4. 17	2, 157	Mining town.
Douglasville	1. 54	15. 61	2. 63	....	Saloon.
Brown's Flat	0. 89	16. 50	1. 74	1, 964	Mining town.
Sonora	1. 74	18. 24	....	1, 816	At post-office.

From West Point to Calaveras Big Trees, Cal.—Atlas-sheet No. 56 B.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From West Point.	From Calaveras.		
West Point	....	....	23.55	2,749	At post-office.
Middle Fork Mokelumne	1.07	1.07	22.48	2,436	Bridge.
Fork of road	1.68	2.75	20.80	....	To Blue Mount City.
Licking Fork Mokelumne	1.37	4.12	19.43	2,196	
South Fork Mokelumne	0.72	4.84	18.71	....	
Railroad Flat	1.49	6.33	17.22	2,606	At post-office.
Forks of road	0.30	6.63	16.92	....	Right-hand road to M mill.
Sheep Herder's Cabin	5.59	12.22	11.33	....	Wood, water, and g early summer.
Summit	5.05	17.27	6.28	4,658	
San Antonio Creek	3.12	20.39	3.16	3,848	Crossing near Dunl saw-mill.
Big Tree road	0.57	20.96	2.59	....	
Fourteen-Mile House	1.38	22.34	1.21	....	
Big Tree Hotel	1.21	23.55	....	4,730	Calaveras Grove.

From Antelope Springs to Volcano, Cal., via Antelope and Pine Grove Turnpike.— sheet No. 56 B.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Antelope Springs.	From Volcano.		
Antelope Springs	....	....	14.62	4,272	
Forks of the road	0.32	0.32	14.30	....	Right-hand road to D Fiddletown, &c.
Ranch	5.24	5.56	9.06	....	
Ranch	1.27	6.83	7.79	....	Watering-trough, w and forage.
Harkness Ranch	1.00	7.83	6.79	....	
* Road forks to West Point	1.39	9.22	5.40	....	
† Foster's Ranch	0.68	9.90	4.70	2,881	Wood, water, and fo
Forks of the road	1.84	11.74	2.88	....	Road to Volcano fork right from Antelo Pine Grove roads.
Volcano	2.88	14.62	....	2,075	
* *The following are the distances on the West Point Fork:*					
Forks of the road	....	....	6.39	....	Leave Antelope a Grove road.
Divide between North Fork Mokelumne and South Fork Sutter Creek.	0.39	0.39	6.00	....	Road forks west.
Crossing North Fork Mokelumne	2.20	2.59	3.80	2,091	Suspension bridge.
West Point Post Office	3.80	6.39	....	2,749	Mining village.

† Not the same station given on the Amador road.

From Hite's Cove to Mariposa Road, Cal.—Atlas-sheet No. 56 D.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Hite's Cove.	From Mariposa road.		
Hite's Cove	....	....	16. 29	....	
Bobbio's Ranch, or Snyder Gulch	5. 88	5. 88	10. 41	....	
Saw-mill on Footman's Gulch	1. 07	6. 95	9. 34	....	
Snow Creek	4. 44	11. 39	4. 90	....	
Mariposa road	4. 90	16. 29	....	....	260 yards east of Boot-jack Ranch.

LISTS OF DISTANCES BETWEEN IMPORTANT POINTS MEANDERED BY PARTY NO. 1, COLORADO SECTION, DURING 1878.

Fest's Ferry, N. Mex., to Saint John's, Ariz.
Springerville, Ariz., to Milligan's road, Ariz.
Springerville, Ariz., to Luera Spring, N. Mex.
Ojo Caliente, N. Mex., to Fort Tulerosa, N. Mex.
Fort Bayard, N. Mex., to Mexican Boundary, via Eureka.
Fort Bayard, N. Mex., to Mexican Boundary, via La Tenaja.
Fort Bayard, N. Mex., to Las Cruces, N. Mex.
Fort Bayard, N. Mex., to Palomas, N. Mex.
Silver City, N. Mex., to Fort Tulerosa, N. Mex.
Saint John's, Ariz., to Springerville, Ariz.
Alamillo, N. Mex., to Fort Bayard, N. Mex.

From Fest's Ferry, N. Mex., to Saint John's, Ariz.—Atlas-sheets Nos. 84, 77, and 76.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Fest's Ferry.	From Saint John's.		
Fest's Ferry	....	....	179. 47	4, 184	Ferry and ford on Rio Grande.
Alamosa	22. 50	22. 50	156. 97	5, 177	Mexican town; water and grass; wood scarce.
Ojo Caliente	17. 20	39. 70	139. 77	6, 081	Hot springs; water, wood, and grass; Indian reservation.
Forks (to Patterson)	8. 70	48. 40	131. 07	6, 464	Wood and grass; no water. Do.
Divide	7. 00	55. 40	124. 07	7, 199	Crossing of dry plain.
North Star road	5. 50	60. 90	118. 57	7, 174	Water, wood, and grass.
Luera Spring	7. 80	68. 70	110. 77	7, 585	Good water, wood, and grass.
Ensinoso	16. 50	85. 20	94. 27	7, 204	Fine timber and grass; no water.
Continental Divide	14. 00	99. 20	80. 27	7, 977	
Rito Mangos	6. 20	105. 40	74. 07	7, 319	Mexican settlement; water, wood, and grass.
Rita Quemada	13. 68	119. 08	60. 39	6, 827	Do.
Forks (to Springville)	21. 00	140. 08	39. 39	....	Wood and grass.
Salt Lake	0. 50	140. 58	38. 89	6, 344	Sweetwater spring at lake; wood, and grass.
Pond	5. 00	145. 58	33. 89	6, 472	Water most of the year; wood and grass.
Tule Spring	16. 00	161. 58	17. 89	5, 861	Water and grass; wood near by.
La Pilla	4. 95	166. 53	12. 94	5, 850	Do.
Saint John's	12. 94	179. 47	....	5, 650	Mexican town; water and grass; no wood.

The grade on this route is excellent, and road-bed generally very good, with little sand. Somewhat marshy at intervals between Rita Quemada (where the Albuquerque freight road joins) and Tule Spring in the wet season.

From Springerville, Ariz., to Milligan's Road, via Los Lentes.—Atlas-sheets Nos. 76 and 83.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Springerville.	From Milligan's Road.		
Springerville	....	....	60. 64	6, 862	Becker's store.
Cienega	10. 25	10. 25	50. 39	7, 476	Ranches, water, wood, and grass.
William's Ranch	6. 25	16. 50	44. 14	7, 487	Upper ranch, on Nutrioso Creek.
Divide	6. 29	22. 79	37. 85	8, 262	Fine timber and grazing; water near on either side.
Bush's Ranch	2. 87	25. 66	34. 98	7, 704	Upper ranch on San Francisco River.
Settlement	2. 75	28. 41	32. 23	7, 663	Road leaves valley.
Stream	4. 07	32. 48	28. 16	7, 671	Impassable for wagons; hills descending to stream; water, wood, and grass.
San Francisco River	3. 61	36. 09	24. 55	7, 235	Water, wood, and grass; road in poor condition.
Mexican Ranch	6. 18	42. 27	18. 37	6, 733	Do.
Los Lentes	3. 25	45. 52	15. 12	6, 542	Mexican settlement; water, wood, and grass.
Paria's Spring	5. 70	51. 22	9. 42	6, 896	Water, wood, and grass.
Milligan's Road	9. 42	60. 64	....	7, 156	Carrizo Spring 0.5 mile to the east.

This road is good to settlement, but little used, and the present route is impracticable between settlement and where it rejoins river. Good from Los Lentes to Milligan's Road.

From Springerville, Ariz., to Luera Spring, N. Mex., via Milligan's Road.—Atlas-sheets Nos. 76, 83, and 84.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Springerville.	From Luera Spr gs.		
Springerville	....	....	110. 25	6, 862	
Coyote Spring	9. 10	9. 10	101. 15	6, 874	Water, wood, and grass; road forks to Salt Lake.
Cienega Amarilla	11. 31	20. 41	89. 84	7, 179	Water, wood, and grass.
Oak Spring	12. 47	32. 88	77. 37	7. 741	Do.
Rancheria Vieja	4. 50	37. 38	72. 87	7, 300	Water scant; 0.5 mile up cañon wood and grass.
Road Junction	10. 40	47. 78	62. 47	7, 220	Carrizo Spring 0.5 mile up east drain, at junction of dry drain of Apache Creek.
Apache	5. 10	52. 88	57. 37	7, 324	Water, wood, and grass; Mexican settlement.
Gallo Spring	4. 90	57. 78	52. 47	7, 587	Do.
Forks to Tulerosa	8. 90	66. 68	43. 57	7, 174	Through northern cañon.
Divide and forks	3. 81	70. 49	39. 76	7, 155	Upper road to Tulerosa.
Forks (to Patterson's)	5. 46	75. 95	34. 30	6, 912	Dry plain.
Horse Spring	9. 30	85. 25	25. 00	7, 045	Ranch; water and grass.
Rito Mangos road	23. 00	108. 25	2. 00	....	Wood and grass.
Luera Spring	2. 00	110. 25	....	7, 585	Water, wood, and grass.

Road in good condition for wagon train, with the exception of a short piece between Apache and the Gallo; this, however, may be avoided by taking the road to the left at "Road Junction" and passing by way of Carrizo Spring, join the main road 1 mile before reaching the Gallo. This route will be found to be a shorter distance by about 2 miles than the one given.

Ojo Caliente to Fort Tulerosa (abandoned), N. Mex.—Atlas-sheets Nos. 84 *and* 83.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Ojo Caliente.	From Fort Tulerosa.		
ite	....	....	64. 96	6, 081	Indian agency.
	8. 70	8. 70	56. 26	6, 464	Wood and grass; no water.
Spring	4. 30	13. 00	51. 96	7, 182	Water scarce; wood and grass plenty.
tar road	4. 00	17. 00	47. 96	7, 325	Wood and grass.
ole	2. 00	19. 00	45. 96	7, 416	Fine grazing; wood; water not permanent.
	0. 50	19. 50	45. 46	7, 464	Leaves North Star road.
ole	6. 80	26. 30	38. 66	7, 335	Grass; little wood; water in wet season.
gustin Plain	6. 50	32. 80	32. 16	6, 780	Fine grazing, east side.
n's Ranch	19. 50	52. 30	12. 66	6, 720	Water and grass.
ntal Divide	4. 16	56. 46	8. 50	6, 912	Forks, upper road; water, wood, and grass.
rosa	8. 50	64. 96	....	6, 612	Old post; Mexican settlement.

ad with the exception of a steep hill between Forks and Water-hole. Intersection of Horse ad, 10 miles from Patterson's.

rt Bayard, N. Mex., to Mexican Boundary, via Eureka.—Atlas-sheets Nos. 84 *and* 90.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Fort Bayard.	From Mexican Boundary.		
rd	....	....	92. 18	6, 068	
Tejo	11. 20	11. 20	80. 98	5, 478	Warm spring; good water and grass; no wood.
anch	0. 80	12. 00	80. 18	5, 405	Water and grass; no wood.
ring	15. 75	27. 75	64. 43	5, 001	Water and grass.
	0. 40	28. 15	64. 03	4, 975	To Carrizillo Spring.
	38. 30	66. 45	25. 73	4, 746	Well; water scarce; grass; no wood.
a	3. 53	69. 98	22. 20	4, 756	Spring; good water; grass; little wood.
Boundary	22. 20	92. 18	....	....	Dry plain; grass; no wood.

Davis Ranch and Cow Spring, road crosses a number of dry ravines and is somewhat broken. good except a short miry piece in drain from Silver City. Good grass is found between Cow d Eureka, but no wood except occasionally mesquite, soap weed, or cactus. From the Mexican to Mesquite Spring the distance is 3.8 miles.

From Fort Bayard, N. Mex., to Mexican Boundary.—Atlas-sheets Nos. 84 and

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Fort Bayard.	From Mexican Boundary.		
Fort Bayard			75. 80	6, 068	
Cow Spring	27. 75	27. 75	48. 05	5, 001	Water and grass; n
La Tenaja	32. 30	60. 05	15. 75	4, 701	Water scarce; w grass.
Carrizillo Spring	10. 00	70. 05	5. 75	4, 457	Water and grass; n
Mexican Boundary	5. 75	75. 80			Dry, grassy plain.

An old and much traveled road to Chihuahua. Bed very good. From Mexican Boundary to Spring, eighteen miles; water holes five miles across the boundary.

From Fort Bayard to Las Cruces, N. Mex.—Atlas-sheet No. 84.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Fort Bayard.	From Las Cruces.		
Fort Bayard			101. 20	6, 068	
Apache Tejo	11. 20	11. 20	90. 00	5, 478	Warm spring; go and grass.
Hot Springs	9. 50	20. 70	80. 50	5, 008	Government agenc water and grass.
Miembres	5. 00	25. 70	75. 50	4, 920	Town and crossin water and grass.
Old Fort Cummings	19. 50	45. 20	56. 00	4, 840	Government agenc water and grass.
Slocum	31. 10	76. 30	24. 90	4, 519	Do.
Forks*	5. 00	81. 30	19. 90	4, 596	Near Fort Selden; try; no wood.
Picacho Crossing	15. 70	97. 00	4. 20	3, 784	Ford of Rio Grande ous; quicksand b
Las Cruces	4. 20	101. 20		3, 797	Town and post-offi ernment agency.

This is the stage-route from the Rio Grande to Fort Bayard.

*** Freight trains that go over the Jornada del Muerto can cross at Fort Seldon by the ferry stage-road at the Forks 11.07 miles distant.**

From Fort Bayard to Palomas, N. Mex.—Atlas-sheet No. 84.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Fort Bayard.	From Palomas.		
Fort Bayard			82. 40	6, 068	Government post.
Santa Rita	6. 00	6. 00	76. 40	6, 161	Settlement; copper mines.
Magruder's	9. 60	15. 60	66. 80	5, 811	Reduction works.
Crossing of Rio Mimbres	10. 50	26. 10	56. 30	5, 355	Bad in wet season.
Forks of trail	1. 27	27. 37	55. 03	5, 442	On bluff.
Nine-mile Cañon	3. 80	31. 17	51. 23	5, 413	Water in wet season; wood and grass.
Spring	8. 90	40. 07	42. 33	6, 223	Water, wood, and grass.
Berenda Creek	3. 65	43. 72	38. 68	5, 489	Do.
Road	5. 80	49. 52	32. 88	5, 047	Grass; little water and wood.
Oak Spring	4. 80	54. 32	28. 08	5, 243	Good water; wood and grass.
Apache Cienega	1. 68	56. 00	26. 40	5, 291	Water and grass; no wood.
Hillsboro	4. 24	60. 24	22. 16	5, 224	Mining town; gold.
Animas River (trail)	10. 66	70. 90	11. 50	4, 470	Water, wood, and grass.
Palomas	11. 50	82. 40		4, 127	Mexican town on Rio Grande.

Good road and easy grades to forks of trail and road beyond the crossing of the Miembres. The route is then by trail to where it meets the Hillsboro road, 1.75 miles to north of McEver's Ranch. From Hillsboro to Palomas the route is by trail across the plains.

From Silver City to Fort Tulerosa (abandoned), N. Mex.—Atlas-sheets Nos. 84 and 83.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Silver City.	From Fort Tulerosa.		
Silver City			120. 95	5, 771	Mining town and post-office; population, 1,400.
Old saw-mill	8. 25	8. 25	112. 70	6, 042	Wood, water, and grass; road.
Walnut Creek	4. 25	12. 50	108. 45	5, 550	Wood, water, and grass; trail.
Bear Creek	8. 15	20. 65	100. 30	4, 737	Dry bed; rough country; wood plenty; trail.
Upper Gila	8. 75	29. 40	91. 55	4, 428	Settlement; wood, water, and grass; trail.
Patterson's Ranch	5. 10	34. 50	86. 45	4, 590	Wagon road; fine grazing; cottonwoods.
Springs	2. 30	36. 80	84. 15	4, 697	Head Creek; cottonwoods; fine grazing.
Spring	13. 75	50. 55	70. 40	4, 968	Good water 200 yards down gulch; little wood; fine grazing.
Whitewater Creek	12. 15	62. 70	58. 25	4, 678	Settlement; water, wood, and grass.
Ranch	6. 50	69. 20	51. 75	4, 863	Meadows; water and grass.
San Francisco River	3. 00	72. 20	48. 75	4, 914	Crossing.
Do	8. 00	80. 20	40. 75	5, 168	Return to river.
San Francisco (lower) plaza	15. 41	95. 61	25. 34	5, 639	Mexican town; wood, water, and grass.
San Francisco (middle) plaza	2. 45	98. 06	22. 89	5, 638	Do.
San Francisco (upper) plaza	2. 14	100. 20	20. 75	5, 688	Do.
ort Tulerosa (abandoned)	20. 75	120. 95		6, 612	Do.

This route intersects the main wagon route to Tulerosa at Patterson's Ranch, which, from Silver ity, passes by Mangos Spring and old Fort West, and is about four miles longer than the route given. om Whitewater the road has been little used, and that portion which is in the cañon of the San Francisco, between San Francisco River and lower plaza, is almost impassable for wagons.

From Saint John's, to Springerville, Ariz.—Atlas-sheet No. 76.

	Distance in miles.			Altitude in feet above sea-level.	Remark
	Between consecutive points.	From Saint John's.	From Springerville.		
St. John's			31. 80	5, 650	Mexican town on orado; water no wood.
Chriswell's Ranch	6. 50	6. 50	25. 30	5, 772	Three springs; al
Tule Springs	5. 00	11. 50	20. 30	5, 807	Water, wood, a Mexican ranch.
Ford	4. 00	15. 50	16. 30	5, 875	Do.
Vigil's Ranch	2. 50	18. 00	13. 80	6, 034	Do.
Ford	1. 65	19. 65	12. 15	5, 967	Do.
Springerville	12. 15	31. 80		6, 862	Becker's store and

Road hilly in parts, but generally good, and follows up the Little Colorado River.

Alamillo to Fort Bayard, N. Mex., via Georgetown.—Atlas-sheets Nos. 77 and 84.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Alamillo.	From Fort Bayard.		
	....	....	181. 87	4, 600	On Rio Grande; water, wood, and grass.
nzo Spring	7. 37	7. 37	174. 50	5, 326	Water, wood, and grazing.
Spring	17. 61	24. 98	156. 89	6, 398	Water and grazing; little wood.
Spring	19. 48	44. 46	137. 41	7, 602	Good water; wood and grass abundant.
stream	2. 50	46. 96	134. 91	7, 740	Water in wet season; wood and grass plenty.
Rocks	11. 83	58. 79	123. 08	7, 178	Water in wet season; fine grazing and wood.
jo Caliente)	6. 33	65. 12	116. 75	7, 174	Dry prairie.
ole	10. 21	75. 33	106. 54	7, 416	Water in wet season; wood and grass plenty.
atterson's Ranch)	0. 50	75. 83	106. 04	7, 464	Road from Ojo Caliente to San Augustin plain and Patterson's Ranch.
	11. 25	87. 08	94. 79	7, 291	0.5 mile east of road; fine grazing.
Ranch	2. 10	89. 18	92. 69	7, 256	Fine water and grazing; wood abundant.
	13. 40	102. 58	79. 29	6, 927	Old Camp Sherman; water, wood, and grass.
s Creek	8. 20	110. 78	71. 09	6, 593	Water, wood, and grass.
er	6. 34	117. 12	64. 75	6, 188	Old Camp Vincent; junction Warm Spring Creek.
reek	4. 18	121. 30	60. 57	6, 329	Bad crossing in wet season.
iver	14. 90	136. 20	45. 67	6, 702	Water, wood, and grass.
añon	6. 65	142. 85	39. 02	7, 595	Do.
Creek	5. 58	148. 43	33. 44	7, 344	Do.
ht's Ranch	9. 74	158. 17	23. 70	6, 237	Water, wood, and grass; 0.5 mile from Mimbres River.
o Magruder's)	8. 15	166. 32	15. 55	5, 864	Wood, water, and grass.
own	3. 50	169. 82	12. 05	6, 455	Mining town; wood and water.
ita	6. 10	175. 92	5. 95	6, 161	Copper mines; wood, water and grass.
o Santa Clara)	3. 10	179. 02	2. 85	5, 857	
s	1. 35	180. 37	1. 50	6, 028	Gold mines; arrastra.
rd	1. 50	181. 87	....	6, 068	Government post; post-office.

ater part of this route is along the North Star road, which leaves the Rio Grande near
of the Puerco River, and passing by Ojo de la Quinca joins this route near the north point
na Mountains, where ther oad from Socorro also joins. At Point of Rocks the road forks to
ing, distant 16 miles. From forks (Ojo Caliente) to Ojo Caliente the distance is 21.20 miles.
te to Shaw's Ranch, partly by road and partly by trail, the distance is 18.8 miles. Below old
rman the road is in a closed marshy cañon for about two miles; road follows down Gila River
p bed of Black River one mile, after crossing. The distance can be shortened several miles
trail to left at Agate Creek and join road again on high ridge to south; distance by trail 4.66
wn Rocky Cañon for four miles the road is very bad and almost impassable for wagons. Farm-
nents along Mimbres River between McKnight's and Magruder's.

MINING NOTES.

overground survey of the Washoe mining region was carried to
tion, the data for the contouring of the southeast corner having
ecured early in the season. The remaining examinations were
d to air velocities, volumes and temperatures in some of the
nportant shafts, various levels, and in the Sutro Tunnel. Collec-
om the ore channels and country rock were made from shafts,
and tunnels, as circumstances permitted.

temperatures now being made at a few of the main shafts show
, and promise future interesting results. The contour map, drawn

to a scale of 1 inch to 500 feet, is completed. The map will serve basis for engineering calculations, and also for delineation of the re from such further study of the ore-bearing channels and rocks o region as may be made from time to time.

The outline map, herewith, shows the location and surface ext all the mines for which patents have been issued, as given by a li ceived from the Land Office, up to the date stated on its face, tog with a number of others now on the records of the General Land O and for which application for patent has been made. This map wi printed also in curves, giving differences of elevation of 50 feet. relative and positive elevations of all working shafts are noted, the tion of mills, mining settlements, and their approaches, together croppings, &c. This map illustrates, in a measure, the applicati the surface claim of the last mining law, and shows clearly cases w litigation may readily arise, especially on account of varying angl the side lines of adjoining claims, and because vertical planes p through the end lines of adjoining claims may, in instances, either i sect or enter the adjoining claim at given depths along the dip o lode. This is the more marked in the locations made along the ea line of crop, which is usually but poorly defined.

This map further illustrates the comparatively small amount of gr that the government parts title with in granting patents for mi claims. A transcript has been kept of the progress of the undergr work of the district, and traced copies of the maps secured to kee the set, showing the extent of the mine explorations, and also the pro of the Sutro Tunnel, that has now tapped the vein proper and is ployed as a means of drainage.

The material at hand is sufficient upon which to base cross-sectio the most prominent points along the vein, the horizontal sections o the working levels, and a vertical section along the whole lode.

I desire again to advert to the courtesy shown by Messrs. James Wrinkle and Messrs. Craven, Hoffman, and Gignoux, all mineral veyors of Virginia City, while myself and parties have been engag gathering data for the surface maps and the below-surface workin the Comstock mines.

The contour map, together with the above sections, afford suffi material upon which to base a relief model, showing the shape o surface and the relative positions thereto of the underground work

A condensation of notes made at a number of mining districts i usual form is herewith:

RIDGE BAR MINING CAMP, KERN COUNTY, CALIFORNIA.

[From notes by Lieut. Willard Young.]

This camp had not been regularly organized into a district in Sep ber, 1878, the time of our visit. It is situated in the Kern River Ca about five miles above the mouth.

The claim covers about 160 acres, and consists principally of a gravel deposit, forming a ridge nearly parallel to the river and dir in the bed of the old stream. The camp gets its name from this It was first discovered in April, 1878, and has been worked continu since. The post-office is Bakersfield, distant about 25 miles. The c try rock in the vicinity and above is granite. There are two claims being worked, the Enterprise and the Chinaman. A ditch and fl about 3½ miles in length, are being constructed, to carry the wat

reek to these claims, which, when completed, will furnish about
iner's inches of water. Two thousand five hundred dollars have
been expended on this work, and it is estimated that it will take
nore to finish it. Labor costs about $2 for white men and $1.25
amen, per day. Hay costs 1 cent and barley 2½ cents per pound.
e brought from Bakersfield. There is plenty of wood and grass
icinity. About 25 men are now at work. Country roads are
d. Deer, bear, quail, and grouse are found in the neighborhood.
vel is said to be quite rich, and it is estimated that, by ground-
, one man can wash out $10 per day.

SAN GABRIEL DISTRICT, LOS ANGELES COUNTY, CALIFORNIA.

[From notes by Lieut. Willard Young.]

listrict comprises the whole mountain region drained by the San
River. It was first discovered in 1852, by Captain Hanegar and
s. Driver. Little or nothing was done until 1858; but since this
district has been worked continuously. The post-office is Azusa,
town near the mouth of the cañon. From the main mining camp,
miles up the cañon, to the railroad at San Gabriel Mission is
3 miles. No geological investigation has been made, except
e cañon for about 3 miles above its mouth to the Winston Sil-
e, which was visited by Professor Marcou in 1875.

rincipal work now being done is on the placer mines along the
ere being some hundred or more claims located; and on two
ic claims, comprising large tracts of gravel banks, with ditches
nes to convey the necessary water. These latter have been in
n since 1874, the gravel deposits being some 80 feet in depth,
n 100 to 200 feet above the present river bed. These deposits
st inexhaustible, and will afford employment to the present own-
workers for years to come. There are several veins in the vicinity
Vinston Mine now being worked, all yielding silver ore; but noth-
nite could be ascertained as to their extent or richness. The char-
ics of the ores are the same as those at the Winston, which, in
mposition and in the manner in which they are found, are said
ble very closely the rich silver ores of Virginia City, Nev. All
hus far have shown the presence of gold. The amount of money
d in constructing ditches and in machinery and labor for the
ic claims is about $32,000. Amount of gold extracted per annum
ese claims about $12,500. Expended on Winston Mine, $8,000,
lly in running tunnels and shafts. Little or no returns have
n realized.

lacer mines have been worked principally by Mexicans, and it is
ble, on that account, to obtain any statistical information. It is
l, however, that the total amount of gold produced from these
ince 1858 will exceed $2,000,000.

er, in considerable quantities, abounds in the entire district, with
neries on the northern and eastern boundaries. The district is
tered by the San Gabriel River and its tributaries, which afford
n sufficient quantity for hydraulic mining and milling purposes.
d up the cañon is very rough. Deer, bear, quail, wild pigeons,
y squirrels abound. There are now about 150 inhabitants in the
Hay, grain, and farm produce are easily obtained from the
briel Valley. Labor costs $2 per day.

SAN ANTONIO DISTRICT, SAN BERNARDINO COUNTY, CALIFORNIA.

[From notes by Lieut. Willard Young.]

This district comprises the country drained by San Antonio Creek. It was first organized in 1872, and was reorganized in October, 1878. But very little work has been done in this district since its first discovery. The post-office is Cucamonga; and Cucamonga Station, distant 11 miles, is the nearest railroad point. No geological investigation has been made. Mineral croppings are found in the cañon on either side of the creek; and one ledge is situated near the summit of San Antonio Peak. None of them have yet been developed to any extent. The principal mines are the Shell Bark, Gilbert, and Elmore, all placers; and the Clark, near the summit of San Antonio, and the Red, White, and Blue, on the east side of the cañon, both quartz.

I was unable to find out the composition of the ores of the Clark and other vein mines. Rich placers, just discovered in the bed of the creek, gave new life to the work there, and, as a consequence, locations have been made along the creek for nearly its whole length. Nothing of any consequence had been done up to the time of our visit. Labor costs $2 per day. Hay 1 cent and barley 1½ cents. These and farm produce, &c., are easily obtained from Cucamonga and the valley below. Wood and water are abundant; grass only moderately so. Game is scarce, though deer, mountain sheep, pigeons, and quail are found.

The district will, I think, never be of any great importance.

HOLCOMB VALLEY DISTRICT, SAN BERNARDINO COUNTY, CALIFORNIA.

[From notes by Lieut. Willard Young.]

This district was first discovered in 1860, by William Holcomb, and was organized in the spring of 1861. It has been worked continuously since that time. The post-office is San Bernardino, distant by trail 40 miles, and by wagon-road 75 miles. A good road runs from Cajon Pass to the district. It is situated in the mountains, north by northwest from San Bernardino Mountain, and is bordered on the north by the Mojave Desert; on the south by the Santa Ana River; on the east by Bear Valley; on the west by the desert hills, near the forks of the Mojave River. The district is about 10 miles square, and mineral croppings are found pretty nearly over the whole area. No special geological investigations are known to have been made.

The general trend of the mountains in the vicinity is from west to east, with spurs running from north to south. The mining ledges are situated, some near the top of the mountain, and others in cañons and on both the north and south slope of the mountains. The general direction of the lodes is a little north of west, except at the Green Lead Mine, where it runs from north to south. The wall rock is granite, with a dip of 40° to 45° towards the south. Near the Green Lead, which is towards the western boundary of the district, the country rock is limestone and granite. In Holcomb Valley proper the rock is entirely granitic. The gold ores at Holcomb Valley yield from $7 to $80 per ton and are worked by the free process. The silver ores are smelted. There are a great many placer claims here also. The ore from the Green Lead is roasted. At Holcomb Valley the water level has been reached at about 100 feet, more sulphurets being found below than above this level. At the Green Lead, water level was reached at about 300 feet, but no change in the ore was noted. At Holcomb Valley the gold-bearing quartz and the placers are found on the south side of the main mountain ridge. The silver and lead bearing veins are on the north slope of this ridge, towards the desert. The average yield from the latter is about $40. They have not been much developed. The ore from the Green Lead is worked for gold only, but it contains some silver and a great deal of copper.

There was no work being done in the district at the time of our visit, except by a few Spaniards at some of the placers. There are a sawmill and a stamp-mill here, both run by a 10-horse-power engine. The stamp-mill has five stamps of 750 pounds each. A 10-stamp mill, without furnace, would cost, with transportation and putting up, about $12,000.

Mining the ore costs about $7 per ton; milling the ore, $7 per ton; mining labor per day, $3; milling labor, $3,50. Ore that can be stoped by one man in one day, about one ton; amount that can be extracted by one man in one day, about one-half ton. Cost per foot for running a tunnel, $8; for sinking a shaft, $15. Hay costs 1½ cents; barley 4 cents. There are no facilities for raising farm produce; present source of supply, San Bernardino. There is plenty of timber everywhere. Water is found only in wells. Number of inhabitants in the district, 15. Freight costs 2 cents per pound. Game is scarce. Country roads good. Principal mining companies and property holders are, the Holcomb Valley Mining Company (limited), London, England; and the Green Lead Mining Company, Los Angeles, Cal.

BEAR VALLEY DISTRICT, SAN BERNARDINO COUNTY, CALIFORNIA.

[From notes by Lieut. Willard Young.]

The Bear Valley district is situated immediately east of, and adjoining the Holcomb Valley district, of which it used to form a part. It was organized in 1873, and since that time, has been worked continuously. San Bernardino is the post-office and general depot of supply. It is distant 50 miles by trail and 80 miles by wagon-road. The mining ledges here, as at Holcomb, are situated in cañons, along the foot-hills, and near the tops of the mountains. The veins generally run with the country rock. Wall rock is granite and slate. There are good evidences of permanent veins. All the ore is gold quartz, worked by the wet process, and yields about $20 per ton. The principal mines are the Gold Mountain, which has a shaft of 50 feet, and three tunnels, one of 300 feet and two of 100 feet, each; the Memphis, worked only on the surface, the vein being about 600 feet wide; and the Last Chance, worked only on the surface, vein 60 feet wide.

A few years ago there were several hundred inhabitants here, and quite a flourishing town sprang up. It is now pretty nearly deserted. At present, there is one 5-stamp mill in working order, the stamps weighing 350 pounds each. It is of but little value, and cannot work up more than two tons of ore per day. Most of the ore in the district is worked in arrastras, run either by horse or water power. The ore can be mined for about $3 per ton. Milling costs $10 per ton. Labor, forage, produce, &c., the same as at Holcomb Valley. Number of inhabitants in district, about thirty. Freight costs 2 cents; country roads good. Deer, geese, and ducks are the principal game. There is a store in the town of Bear Valley, supplying dry goods, groceries, and provisions. About $215,000 have been expended by the Gold Mountain Mining Company, principally on the mill, now burned down, and in improving the country roads. They have realized about $30,000 in bullion. The Memphis Company have expended $3,000, and have taken out $2,000. The Last Chance have expended $2,000, and have realized $2,000.

LONE VALLLEY DISTRICT, SAN BERNARDINO COUNTY, CALIFORNIA.

[From notes by Lieut. Willard Young.]

This district is situated in the mountains and hills bordering the Mojave Desert, near the San Bernardino Mountain, and lies southeast of Bear Valley district, and immediately adjoining it. It was discovered in 1873 by J. W. Wilson and J. E. McFee, and organized the same year. It has been worked continuously since. It is distant from Whitewater Station, on the Southern Pacific Railroad, by trail 50 miles and by road 85 miles; and from San Bernardino, by road, about 90 miles. The district is approximately 8 miles long, from north to south, by 5 miles broad, and mineral croppings are found over nearly the whole area.

No geological investigation has been made. The general trend of the mountains in the vicinity is northwest and southeast; and the mining ledges are found on either slope. Their general direction is parallel to the mountains, and they run with the country rock, which dips to the southwest, from 30° to 40°. No large leads have yet been developed. Wall rock is granite. The country rock is limestone and granite. The principal ores are gold quartz and galena, associated with iron pyrites and other sulphurets. Considerable copper is found at croppings. No fossils have been found. Gold averages from $35 to $40 per ton; silver, from $35 to $60 per ton. The gold quartz is worked in arrastras, by the wet process. No silver ores are being worked. Gold is present in all the ores.

The principal mines are the Silver Star, Old Jeff, National, Oro Fino, White Stockade, Big Blue, Rough and Ready. None of them have been extensively worked. About $2,000 have been expended on the Big Blue. At some of the others shafts, of from 20 to 30 feet have been sunk. Two arrastras are now being worked. A small smelting furnace was established here but is now abandoned. The ore can be mined for about $4 per ton. Melting the ore by arrastras cost $10 per ton. Labor costs $3 per day. Cost per foot for running a tunnel, from $7 to $10; for sinking a shaft, $8. Hay costs 1 cent, barley 3 cents. There are no facilities for raising produce of any kind. Present source of supply, Whitewater. There is an abundance of fine timber and plenty of wood. Grass and water are very scarce. Inhabitants in district, 10. Price of freight, 2 cents per pound. Deer, antelope, mountain sheep, rabbits, and quail are found, but are not plentiful. Country roads good.

LONE DISTRICT, SAN MIGUEL COUNTY, NEW MEXICO.

[From notes by Lieut. Rogers Birnie, jr.]

This district was discovered in 1870 and organized in 1871, and has since been worked continuously. It is 350 miles from the terminus of the Atchison, Topeka and Santa Fé Railroad, via Hot Spring, Cottonwood Ranch, Fest's, La Parida, Punta del Agua, and Anton Chico. The district is 5 miles square, and about 1,200 acres near the center contain the mineral croppings, with a trend northeast and southwest. The deposits occur in limestone rock found crossing cañons and along the east side of the Lone Mountain hills, which trend nearly north and south. The wall rock is nearly perpendicular, with continuous veins, which have been easily traced to a depth of 50 feet by shafts. Much of the ore, however, has been taken from apparently isolated pockets. The ore is worked by the raw amalgamation process. Assorted ore averages 75 to

30 ounces of silver per ton. The characteristics of the ore are native silver and chloride, heavy brittle sulphurets in quantity, and in places lead, copper, and iron. Gold occurs in some of the mines.

The principal mines now operated are Home Ticket; vein opened 12 to 14 feet in depth for 1,000 feet; two shafts, 20 and 48 feet, with some water in the latter, probably from a crevice. The vein is 18 inches wide, dark and light quartz, in hard red limestone. The hanging wall is free and well defined, and has a pitch of 80°. Pino Carto, recently opened on what seems to be a well-defined ledge in limestone. A small opening has yielded ore, producing 52 ounces per ton. Bismarck, recently opened; two tons of ore yielded 33 ounces each. Red Lead has five shafts, one of 50 feet with a 10-foot drift; not worked during the year. There are several smaller mines with streaks of good ore, but not sufficient to pay for working. On all the mines labor has chiefly been performed by the owners. About 250 tons of ore was worked at the mines during the year, averaging about 100 ounces per ton.

There is one mill with an engine of 25-horse power, 4 stamps of 500 pounds, 2 ordinary arrastras for grinding pulp, and 2 amalgamating pans, old Varney patterns; capacity, 3 tons in 24 hours.

Georgetown ore is worked at this mill, averaging 150 ounces per ton; and Lone Mountain ore, averaging 100 ounces per ton, the charges being $20 to $25 per ton. The superintendent of the mill claims that grinding by arrastras saves 15 per cent. over iron pans. As most of the work is done by the mine owners, no prices of labor are determined. But little land in the district is tillable. Hay is $20 per ton, and grain 2½ cents per pound. There are a few small springs and a small stream in the district. Wood has to be brought 9 miles. Freight costs 4 cents from the railroad and 3 cents back. The roads are excellent. The district contains 38 inhabitants and about 500 head of stock. There is good grazing.

CHLORIDE DISTRICT, SILVER CITY, NEW MEXICO.

[From notes by Lieut. Rogers Birnie, jr.]

This district was discovered and organized June 3, 1870, by John and James Bullard, E. Necks, and John Swisshelm. It has been worked continuously, although with decreased activity, since 1875. It is situated about 500 miles from Trinidad, the terminus of the railroad. The district was examined geologically by Dr. O. Lew, of this expedition, in 1873.

The country rock is very much broken. Slate and limestone predominate, with an occasional dike of igneous rock. The slate is usually barren, the ore occurring in streaks in limestone, being richest near line of contact with the slate. It is doubtful if true veins exist, those being found chiefly in pockets. No fossils. The smelting process failed because of the predominance of chloride, as also did roasting. The amalgamation wet process is now employed. The ore contains much base metal, and the workings have saved only about 60 per cent. of value. The ore has not been weighed, but during the past year the Bremen mill has run about 485 tons from the "'76" mines, the average working being 45 ounces to the ton. The ores are chiefly chlorides, together with black sulphurets and some native silver. There is probably a small amount of bromine copper; also lead, antimony, and iron. The vein matter is feldspar mixed with ores. The ores contain no gold. The principal mines are the '76, Two Ikes, New Issue, Republican, and R. E. Lee.

The '76 mine has several shafts sunk through a bed of slate, under which the ore occurs in beds and pockets.

The Providence is of the same class. The Two Ikes has been but little worked since 1875; one shaft is sunk 135 feet with driftings. An attempt to work this mine was made within a year, but failed to pay. $351,000 have been taken from this mine; expenses, $121,000. The New Issue has been idle for three years; but within six months a few tons of ore have been extracted, giving 109 ounces to the ton. The Republican has three shafts, 125, 35, and 48 feet; no drifts. Accurate information as to the amount expended in developments could not be obtained. The Bremen Mill has a 25-horse-power engine, 10 stamps, 10 Varney pans, 4 settlers. The Pope Mill has been idle for two years; it was run at a loss.

The average cost per ton for mining ore is $7; for roasting and milling, $12; for mining labor per day, Mexican, $2; American, $3. But little stoping is done. Amount of ore that can be extracted by one man per day, one-half ton; average cost per foot for running a tunnel, $7; for sinking a shaft, $9; for running a drift, $7. Hay is most abundant, and easily obtained from the adjacent plains; price per ton, $15; grain, 2½ to 3 cents per pound. There are 5,000 to 6,000 acres of cultivable land on Mimbres and Gila Rivers within one day's journey of town. Timber is at present obtained from Burro Mountains. Timber is worth $35 per thousand at mill; shingles, $5; laths, $9. At present rate of consumption, timber will last four years longer. Water is readily obtainable from wells 15 feet deep; the San Vincente spring in the town runs 35 inches.

MIMBRES SILVER MINING DISTRICT, NEW MEXICO.

[From notes by Lieut. Rogers Birnie, jr.]

Discovered and organized by James D. Fresh April–June, 1873. It has been worked continuously. It is distant from Trinidad 525 miles. The district covers an area of 3 miles extending northeast and southwest. Geological investigations have been made by C. W. Irish, Iowa City, Iowa. The ledges are on the southeastern slopes of the Parapet Mountains. The deposits are in chimneys in limestone with frequent branches. The pockets occur very irregularly, the richest ores generally in vicinity of granite dikes. No real fissure veins can be traced. No fossils have been found in the ore-bearing limestone; in the limestone cappings of the hills many occur. The ores are worked by the free amalgamation process, one ton yielding 150 ounces. They occur as chlorides, sulphurets of silver, and as carbonates. Iron, antimony, and arsenic occur in small proportions. No gold is found. Water has not been reached. The principal mines are: 1. McGregor, with 12 shafts, averaging 50 feet each, and 2,500 feet of drifts; 2. Commercial, with 10 shafts of 50 feet each and 3,000 feet of drifts; 3. McNulty; 4. Naiad Queen, with 3 shafts aggregating 335 feet and connecting drifts; $600,000 have been expended in developments, all of which has been drawn from the mines. The camp has yielded $800,000.

There are two mills in the district. The Mimbres Mining and Reduction Works is situated on Mimbres River, 3 miles from Georgetown, and is run by water-power. It has 1 Blake crusher, capacity 25 tons per day; 5 stamps, capacity 4 tons per day; 3 settlers and 2 arastras. The capacity of this mill is soon to be materially increased.

Meredith's mill, on the Mimbres, is also run by water-power. It has no crusher; it has 3 stamps. Capacity of mill, 2½ tons per day. Cost of a 10-stamp mill, without roasting furnace, $15,000. Average cost of mining ore per ton, $40; for roasting and milling per ton, including transportation to mill, $30; average mining labor per day, $3; average amount of ore that can be extracted by one man per day, one-twelfth of a ton (200 pounds); average cost per foot for running a tunnel, $12 per foot; for sinking a shaft, $7.50 per foot; for running a drift, $12. Hay costs $20 per ton. There are about 5,000 acres of tillable land on Mimbres; stock facilities are excellent. A good supply of timber is found within 12 miles; wood abundant. Willow Spring in the town runs 4 or 5 inches of water, and, by digging, its capacity can probably be doubled.

There are 500 inhabitants in the district, the mines affording employment to 100 men. Four stages a week run to Silver City. Inward freight costs 4 cents per pound; outward, 3 cents. There are 3 stores, 1 school-house, 1 banking house; 100 head draught animals, 1,200 cattle, and 2,000 sheep and goats sum up the stock in the vicinity. Bear, deer, and quail are found. The country roads are good. There are no Indians in the district.

PINOS ALTOS DISTRICT, GRANT COUNTY, NEW MEXICO.

[From notes by Lieut. Rogers Birnie, jr.]

This district was discovered and organized July, 1859, by Isa Langston, Captain Snively, and Mr. Birch. It has been worked continuously, but much less actively, since the winter of 1866. An area of about 3 miles square is covered by the outcroppings. Geological investigations have been made by Ross Brown; no special surveys obtainable.

The general direction of the lodes is north and south, and conforms to country rock. Uniformly low-grade ores are found in granite, the richest near junction of slate and granite; there are some rich deposits of gold in slate. Pyrites is met with in varying quantities; free gold is found with it. There are five old and well developed and apparently genuine fissure veins. The vein matter is usually inclosed by talc. The dip is nearly uniform (to west) from 75° to 82°. Granite, quartzite, and slate constitute the country rock. No fossils are found. The ores are worked by arastra process and only for free gold. A large quantity from Pacific mines Nos. 1 and 2 is said to have yielded an average of $40 to the ton. The Mina Grande about $8 per ton; but the latter ore is free from metals and pays best to work. Water is reached in Pacific mines about 300 feet from summit of hill; ore changes to pyrites. No water in Atlantic, which is sunk 125 feet.

Atlantic and Mina Grande ore contains a little iron and silver; Pacific contains iron pyrites in quantity, copper, carbonate and chloride of silver, iron, and probably some zinc. In the Langston silver predominates, and assays give $100 to the ton. All the above are worked only for gold. The principal mines are: 1. Atlantic with 1 tunnel 300 feet; 4 shafts 125 feet, 100 feet, 80 feet, 80 feet, and surface worked 15 to 20 feet for about a mile. 2. Mina Grande with 1 tunnel 45 feet long; 2 shafts aggregating 250 feet, and surface worked 10 or 12 feet for about 700 feet. 3. Pacific No. 1; 2 tunnels 700 feet and 75 feet; 12 shafts aggregating 800 feet; surface worked 12 to 15 feet for about 900 feet. 4. Pacific No. 2; tunnel now being run is 186 feet; 6 shafts aggregating 480 feet; surface worked 15 feet for 300 feet. 5. Langston; tunnel 500 feet long; 2 shafts 60 feet each. 6. Arizona; tunnel 200 feet long; 4 shafts aggregating 300 feet. 7. A number of narrow seams, many of which have proved rich. 8. A number of placer diggings on both north and south slopes of Pinos Altos Peak. As to amount expended in developments, no strictly reliable figures could be obtained; the following estimates were given:

	Expended.	Extracted.
Pacific No. 1	$250,000	$125,000
Pacific No. 2	75,000	25,000
Arizona	60,000	20,000
Atlantic	40,000	20,000
Mina Grande	4,000	10,000
Unnamed veins		250,000

There are 3 mills with one 15 and two 25 horse-power engines, besides some 15 arrastras. A 10-stamp mill costs $15,000; an ordinary smelting furnace, $2,000; average cost per ton for mining ore, $5; for roasting and milling, $5; of mining labor per diem, $2; of milling labor per diem, $1.50; average amount of ore that can be stoped by one man in a day, one-half ton; average amount that can be extracted by one man in a day, one-half ton; average cost per foot for running a tunnel on main veins, $2; for sinking a shaft on main vein, $2; for running a drift on main vein, $2.50. Shafts and drifts should be run in vein matter.

There is plenty of hay in the vicinity, price $10 per ton; grain 2 cents per pound. The amount of agricultural land is small. Vegetables are raised without irrigation. Timber and wood are abundant and near at hand. There is sufficient water for milling and stock-raising purposes, but not for placer mining except during a few months of the year.

There are 300 inhabitants in the district, 1 school-house, and 3 stores. There is but a limited amount of stock. Deer, bear, turkeys, and quail are found. The roads are good. Freight costs $4 per hundred; back freight, $2.50. The Apaches were very troublesome from 1860 to 1865, and have killed probably 40 men. No depredations have been committed since 1874; none now living in the vicinity.

Placer mining.—There are a number of placer diggings on north and south slopes of Pinos Altos Creek. Work is mostly confined to the months of June, July, and August (the rainy season). About 15 men are now at work, using cradles in the dry season. The average per day per man is $2; $300,000 is the estimated profit from the placers.

LAS ANIMAS DISTRICT, COLORADO.

[From notes by Louis Nell.]

This district was discovered and organized by David Shitsel, May 22, 1877. It is distant from Trinidad 428½ miles. No geological investigations have been made. The district is situated in the foot-hills of the Mimbres Mountains, and is about five miles square; general direction of the lode northeast and southwest. The country rock is granite; no fossils found. The ore contains free gold, is worked by the free process, and yields from $20 to $35 per ton; base metals, copper and iron. Water is reached in some of the mines at a depth of from 40 to 60 feet.

The principal mines are the Snake, Golden King and Extension, Weeks Extension, Bobtail, Red Jacket, Yellow Jacket, Argosy, Eldorado and three extensions. From the Snake about $4,500 (in ore on dump) has been extracted; the same from the Bobtail. Some $20,000 worth of ore has been taken from the district in seven months. A Hillsboro mill was *en route*, and expected to be in operation by January, 1879. Average cost per ton for mining ore, $5; for milling, $10; for mining labor per day, $2.50; average amount of ore that can be stoped by one man in one day, one ton; average amount that can be extracted by one man in one day, about one-half ton; average cost per foot for running a tunnel on main vein, $4; average cost per foot for sinking a shaft on main vein, $5; average cost per foot for running a drift on main vein, $1.25. Shafts and drifts should be run in vein matter.

There is abundance of grazing and plenty of water. Timber is abundant 10 miles from the town. There are about 300 inhabitants, including Mexicans. There are 20,000 head of stock in the vicinity, including sheep, cattle, and horses—principally sheep. The country roads are very poor. The route in use follows up the bed of Animas River, and is subject to "wash-outs." Freight costs 3 to 4 cents; stage fare from railroad, $80. Deer, antelope, bear, rabbits, turkeys, ducks, and geese are found.

AZTEC AND MORENO DISTRICTS, COLFAX COUNTY, NEW MEXICO.

[From notes by Prof. J. J. Stevenson.]

The Aztec mining district, organized in 1869, was visited in 1876 by Mr. Conkling, of this expedition. But little change has taken place since his visit. A few new mines have been opened, but the productiveness of the district has not been increased materially.

The Moreno district, organized in 1869, embraces a part of the Moreno Valley between the mouth of the creek and Elizabethtown, and reaches to the crest of Old Baldy Mountain, so as to join the Aztec district. Placer mining alone is carried on in this district, but the lack of water prevents it from attaining much importance, although the gravels are very rich.

Both of these districts are easily reached by way of an excellent road leading up Cimarron Creek from Cimarron, and are on the direct road from that place to Taos. Wood and grass are abundant, and good crops of all the ordinary grains can be raised within the Aztec district. The Moreno district lies too high for successful farming, though very near the head of Cimarron Cañon wheat and barley have matured.

LOS CERILLOS MINES, SANTA FE DISTRICT, NEW MEXICO.

[From notes by Prof. J. J. Stevenson.]

Los Cerillos are irregular hills, perhaps 20 miles west of south from Santa Fé. Many years ago the Spanish residents worked some silver mines there, but they could not have been very profitable, as the workings are not extensive. The region became the object of attention during 1879, and a large number of miners flocked to it. When visited in June of 1879 it had many prospecting shafts varying from 20 to 50 feet in depth; but the ore streaks were very thin and the prospects not altogether such as to satisfy any but a visionary miner. The ore is galena, carrying silver. Some of the assays show ore of fabulous richness.

The region is arid and no good water has been obtained in the hills. Timber is plenty but the grazing is poor.

PLACER DISTRICTS, SANTA FE COUNTY, NEW MEXICO.

[From notes by Prof. J. J. Stevenson.]

The Placer districts of the Placer Mountains are about 25 and 35 miles, respectively, distant from Santa Fé in a west of south direction. Gold was discovered in the Old Placer during 1828, and the gravels have been worked ever since. The New Placer was discovered at a somewhat later time. Water is scarce at both placers, and but little work can be done.

Quartz mining is carried on in a small way at the Old Placer. The New Mexican Mining Company erected a 20-stamp mill, but it is not in operation. Several lodes have been opened here, but they are irregular in thickness as well as quality. The New Placer was not examined.

In the vicinity of the placers water and grass are by no means abundant, but timber present for all necessities.

NATURAL HISTORY (INCLUDING GEOLOGY, ZOOLOGY, &C.).

Prof. John J. Stevenson submits a preliminary report (Appendix K) of his examinations made along the mountain ranges southward from the Spanish Peaks in Colorado, and between the Rio Grande and the plains as far as the latitude of Santa Fe, lying mostly in atlas-sheets 70 A and 70 C. He was assisted by Mr. I. C. Russell, and the labors of the season proved distinctly satisfactory, both as regards geological data and in the collections of rocks and fossils. Twenty-six distinct coal horizons or beds from Trinidad to the south were noted, their order of succession distinguished, and the complicated axes of several mountain ridges determined. Resuming his labors in May of this year, he reviewed certain points of the field, and carried his examinations to the southern end of the Santa Fe axis, near Galisteo Creek.

Mr. H. W. Henshaw presents an ornithological report (Appendix L) upon regions traversed in 1876, 1877, and 1878, in portions of California, Nevada, and Oregon, as far to the northward as the Columbia River.

The following collections in natural history were made during the season:

Mammals	specimens	8
Mammals (alcoholic)	do	3
Mammal crania		1
Bird skins		243
Bird crania and sterna		7
Birds' eggs		12
Fishes	specimens	200
	lots	12
Snakes	specimens	25
	lots	16
Lizards	specimens	25
	lots	7
Batrachians	specimens	50
	lots	11
Hemiptera	lot	1
Orthoptera	specimens	200
	lots	6
Shells	specimens	25
	lots	3
Crustaceans	specimens	12
	lot	1
Fossil leaves	specimens	72

The list of specimens forwarded during the year to the Smithsonian Institution to be deposited in the National Museum is herewith:

Bird skins	361
Birds' eggs	738
Birds' nests	19
Mammal skins	16
Snakes	24
Lizards	10

chians		12
s	specimens	400
	lots	35
ptera (alcoholic)	specimens	500
	lots	14
ptera (pinned)	specimens	150
	lots	4
ptera	specimens	1
	lots	3
s	specimens	50
	lots	11
aceans	specimens	12
	lots	1
s	specimens	100
	lots	2
tebrate fossils	specimens	2,159
s, approximated		2,494
rals, ores, &c., approximated		1,993

SPECIMENS FORWARDED TO ARMY MEDICAL MUSEUM.

an crania		1
sterna		5
crania		5
mal crania		2
olic mammals	lots	5

PUBLICATIONS.

e following maps have been finished during the year, and will appear
the extra copies asked for of this report, viz:
ogress map for 1879 and seven regular atlas-sheets in hachures,
land classification color added, Nos. 32 D, 47 B, 47 D, 61 D, 73 A,
., and 84 B. Volume VI, Botany, has issued from the Government
ting Office, and Volume VII is passing through the various stages
roof, preparatory to stereotyping. Two thousand extra copies of
Annual Report of 1878 from this office (Appendix N N, Annual Re-
Chief of Engineers) have been published, accompanied by ten sepa-
y bound atlas-sheets.

e following lists show the condition of reports add maps to date:

REPORTS (PUBLISHED).

Quartos.

olume II. Astronomy and Barometric Hypsometry.
olume III. Geology.
olume IV. Paleontology.
olume V. Zoölogy.
olume VI. Botany.
olume VII. Archæology (in hands of printer).

Annuals.

(Separate from Report of Chief of Engineers.)

73, 1874, 1875, 1876, 1877, 1878.

Miscellaneous.

(Quarto, octavo, and pamphlet.)

wo preliminary reports, 1869 (one octavo and one quarto).
reliminary report, 1871 (quarto).
rogress report, 1872 (quarto).

Camps and distances, 1871 (oblong folio).
Camps and distances, 1872 (quarto).
Astronomical report, 1874 (quarto).
Star catalogue (quarto).
List of latitudes and longitudes (extract from Volume II).
Vertebrate fossils of New Mexico (pamphlet).
Catalogue of vertebrates of New Mexico (pamphlet).
Invertebrate fossils (pamphlet).
Catalogue of plants (octavo).
Ornithological specimens (octavo).
Meteorological instructions (octavo).
Barometric hypsometry instructions (octavo).
Field lists of stars (pamphlet).
Logarithm, traverse, and altitude tables (pamphlet).

IN COURSE OF PUBLICATION.

Volume I, Geographical report (quarto).
Geographical positions, distances, &c.

NOTE.—It is intended to submit during the coming year the final report of Prof John J. Stevenson upon the result of his geological investigations of 1878 and 1879, and also his examinations of the coal beds of Eastern Colorado and New Mexico. This report is accompanied by a number of cuts, profiles, and maps, and will require considerable time and expense for its complete production.

MAPS (PUBLISHED).

Topographical.

Three sheets of conventional signs for (1) plotting and for final maps in (2) hachures; and (3) crayon hill shading.

Sheet of that portion of the United States lying west of the 100th meridian, showing ninety-five numbered rectangular divisions, each to appear as separately numbered atlas-sheets, indicating the progress of the survey. (Published for the years 1872-'73-'74-'75-'76-'77-'78-'79.)

Drainage sheet, showing by colors the area of drainage to the Atlantic and Pacific Oceans and the interior basins of the territory of the United States west of the Mississippi. Scale, 1:6000000.

Geological.

Index sheet, showing the general topographical features and the rectangular divisions from Nos. 1 to 95.

Special sheet, embracing portions of Western Utah and Eastern Nevada, representing the location of an ancient fresh-water lake, which included the region of Great Salt, Sevier, and Utah Lakes. Scale, 1 inch to 17 miles.

Special.

Reconnaisance map of parts of Nevada and Arizona. Scale, 1 inch to 12 miles, or 1: 760320.

Map of the Grand Cañon of the Colorado, expedition of 1871. Scale, 1 inch to 6 miles, or 1: 380160. (To accompany Vol. I.)

Topographical map of the vicinity of the Comstock lode in the Washoe mining region, Nevada: area, 119 square miles; scale, 1 inch to 1,500 feet, or 1: 18,000.

Atlas-sheet numbe	Locality.	Scale.	Area, square miles.	Latitude north.		Longitude west from Greenwich.			Remarks.
				°	′	°	′	″	
32*d*	Part of Southeastern Idaho	1 inch to 4 miles.	4, 022. 58	42 43	20 10	111 112	00 22	00 30	* With land classification added.
41*b*	Southeast corner of Idaho and part of Northern Utah.	...do	4, 075. 29	41 42	30 20	111 112	00 22	00 30	‡ Also as land-classification map.
47*b*	Parts of Eastern California and Western Nevada.	...do	4, 178. 42	39 40	50 40	119 120	15 37	00 30	In skeleton.
47*d*	......do	...do	4, 228. 56	39 39	00 50	119 120	15 37	00 30	*‡ Also in hachures with land classification added.
49	Parts of Eastern Nevada and Western Utah	1 inch to 8 miles	16, 813. 96	39 40	00 40	113 116	45 30	00 00	Also in crayon (hachure edition out of print).
50	Parts of Central and Western Utah	...do	16, 813. 96	39 40	00 40	111 113	00 45	00 00	Also in geological form and crayon (hachure edition out of print).
53*c*	Part of Central Colorado	1 inch to 4 miles.	4, 228. 56	39 39	00 50	104 105	07 30	30 00	† Land classification to be added.
57	Parts of Southwestern Nevada and Eastern California.	1 inch to 8 miles.	17, 208. 58	37 39	20 00	116 119	30 15	00 00	(Out of print.)
58	Part of Eastern and Southern Nevada and Southwestern Utah.	...do	17, 208. 58	37 39	20 00	113 116	45 30	00 00	Also in crayon and partly in geological form (hachure edition out of print).
59	Part of Southwestern Utah	...do	17, 208. 58	37 39	20 00	111 113	00 45	00 00	Also in geological form and in crayon (hachure edition out of print).
61*a*	Part of West Central Colorado	1 inch to 4 miles.	4, 278. 00	38 39	10 06	106 108	52 15	30 00	With land classification added (out of print).
61*b*	Part of Central Colorado	...do	4, 278. 00	38 39	10 00	105 106	30 52	00 30	Also as land-classification map (out of print). Geological classification to be added.
61*c*	Part of Southwestern Colorado	...do	4, 326. 00	37 38	20 10	106 108	52 15	30 00	*‡ In skeleton, afterward with land classification; geological classification to be added.
61*c*, sub.	Parts of Southwestern Colorado (San Juan mining region.)	1 inch to 2 miles.	1, 100. 00	37 38	42 07	107 107	15 57	00 00	§ In contours, and also as land-classification map.
61*d*	Part of Southern Colorado	1 inch to 4 miles.	4, 326. 29	37 38	20 10	105 106	30 52	00 30	* † With land classification added.
62*a*	Part of Central Colorado	...do	4, 278. 00	38 39	10 00	104 105	07 30	30 00	‡ Also as land-classification map.
62*c*	Part of Central Colorado	...do	4, 326. 29	37 38	20 10	104 105	07 30	30 00	‡ Do.

* To accompany extra copies of annual report, 1879. ‡ Separate edition with annual report, 1878. † Issued with extra copies annual report, 1877. § Accompanying extra copies annual report, 1876.

Topographical atlas-sheet (published)—Continued.

Atlas-sheet number.	Locality.	Scale.	Area, square miles.	Boundaries.					Remarks.
				Latitude north.		Longitude west from Greenwich.			
				°	'	°	'	"	
65	Parts of Southwestern Nevada and Southeastern California.	1 inch to 8 miles.	17, 587. 88	35 37	40 20	116 119	30 15	00 00	(Out of print.)
65d	Part of Southeastern California	1 inch to 4 miles.	4, 420. 20	35 36	40 30	116 117	30 52	00 30	†Also as land-classification map.
66	Parts of Southeastern California and Nevada, Southwestern Utah, and Northwestern Arizona.	1 inch to 8 miles	17, 587. 88	35 37	40 20	113 116	45 30	00 00	Also in crayon and geological form in part (hachure edition out of print).
67	Parts of Northern and Northeastern Arizona and Southern Utah.	....do	17, 587. 88	35 37	40 20	111 113	00 45	00 00	Also as geological form and in crayon (hachure edition out of print).
69b	Parts of Northern New Mexico and Southern Colorado.	1 inch to 4 miles	4, 373. 74	36 37	30 20	105 106	30 52	00 30	†Also as land-classification map.
69d	Part of North Central New Mexico	....do	4, 420. 20	35 36	40 30	105 106	30 52	00 30	†§ Do.
70a	Parts of Southern Colorado and Northern New Mexico.	....do	4, 373. 74	36 37	30 20	104 105	07 30	30 00	†Also as land-classification map; geological classification to be added.
70c	Part of Northern New Mexico	....do	4, 420. 20	35 36	40 30	104 105	07 30	30 00	†Do.
73a	Part of Southern California	....do	4, 465. 85	34 35	50 40	117 119	52 15	30 00	* With land classification added.
75	Parts of Central and Western Arizona	1 inch to 8 miles.	17, 952. 24	34 35	00 40	111 113	00 45	00 00	§Also in geological form, land classification to be added (hachure edition out of print).
76	Parts of Eastern Arizona and Western New Mexico.	....do	17, 952. 24	34 35	00 40	108 111	15 00	00 00	§Also in geological form (hachure edition out of print).
77b	Part of Central New Mexico	1 inch to 4 miles.	4, 465. 85	34 35	50 40	105 106	30 52	00 30	†Also as land-classification map.
77d	....do	....do	4, 510. 27	34 34	00 50	105 106	30 52	00 30	‡ Do.
78a	Part of North-Central New Mexico	....do	4, 465. 85	34 35	50 40	104 105	07 30	30 00	* With land classification added.
83	Parts of Southeastern Arizona, Western and Southwestern New Mexico.	1 inch to 8 miles.	18, 301. 78	32 34	20 00	108 111	15 00	00 00	§Also in geological form (hachure edition out of print).
84b	Part of Central New Mexico	1 inch to 4 miles.	4, 554. 13	33 34	10 00	105 106	30 52	00 30	** In skeleton. Also in hachures with land classification added.

* To accompany extra copies of annual report, 1879. ‡ Separate edition with annual report, 1878. † Issued with extra copies annual report, 1877. § Accompanying extra copies of annual report, 1876.

NOTE.—The sheets are reproduced as photolithographs in black and underlying tint unless noted otherwise in column of "Remarks."

RECAPITULATION.

raphical atlas-sheets published	28
cing toward completion and to accompany extra copies of the annual report of this office with)	5
lassification sheets published	21
ical sheets published	7
Total	61

MAPS (UNPUBLISHED).

Geological.

ntour map of Ely mining district, Southern Nevada. 1 inch = 12 s. Atlas-sheets, 61 B, 61 C, 70 A, and 70 C., also 52 D, in which field work is necessary.

Special.

ap of portions of Eastern California and Western Nevada, the Lake e region of the Sierra Nevada; area, 2,232 square miles; scale, 1 to 1 mile, or 1:63360.

eat Salt Lake and vicinity, area 5,719.8 square miles, plotted on of 1 inch to 2 miles (more field work required).

Topographical atlas-sheets (unpublished).

Atlas-sheet number.	Locality.	Scale.	Area, square miles.	Boundaries.					Remarks.
				Latitude north.		Longitude west from Greenwich.			
				°	'	°	'	"	
20*a* in part.	Parts of Northern Oregon and Southern Washington.	1 inch to 4 miles.	3,859.85	44 45	50 40	120 122	37 00	30 00	More field-work required (land classification to be added).
20*c* in part.	Part of Northern Oregon	do	3,914.30	44 44	00 50	120 122	37 00	30 00	Do.
29*a* in part.	Part of Central Oregon	do	3,968.85	43 44	10 00	120 122	37 00	30 00	Do.
29*c* in part.	Part of Southern Oregon	do	4,022.58	42 43	20 10	120 122	37 00	00 00	Do.
32*c*	Part of Southern Idaho	do	4,022.58	42 43	20 10	112 113	22 45	30 00	Land classification to be added.
38*b* in part.	Parts of Southern Oregon, Northwestern Nevada, and Northeastern California.	do	4,075.29	41 42	30 20	119 120	15 37	00 30	Land classification to be added (more field-work required).
38*d*	Parts of Northeastern California and Northwestern Nevada.	do	4,127.18	40 41	40 30	119 120	15 37	00 30	Land classification to be added.
41*a*	Parts of Southeastern Idaho and Northwestern Utah.	do	4,075.29	41 42	30 20	112 113	22 45	30 00	Do.
47*a*	Part of Northern California	do	4,178.42	39 40	50 40	120 122	37 00	30 00	Do.
48	Part of Central and Western Central Nevada	1 inch to 8 miles.	16,313.96	39 40	00 40	116 119	30 15	00 00	In hachures only.
52*d* in part.	Parts of Central Colorado	1 inch to 4 miles.	4,228.56	39 39	00 50	105 106	30 52	00 30	Land and geological classification to be added (more field-work required).
56*b*	Parts of Eastern California and Southwestern Nevada.	do	4,278.00	38 39	10 00	119 120	15 37	00 30	Land classification to be added.
56*d*	Part of East Central California	do	4,326.29	37 38	20 10	119 120	15 37	00 30	Land classification to be added (more field-work required).
68 in part.	Parts of Northeastern Arizona and Northwestern New Mexico.	1 inch to 8 miles.	17,587.88	35 37	40 20	108 111	15 00	00 00	More field-work required.
69	Parts of Southern Colorado and Northwestern New Mexico.	do	17,587.88	35 37	40 20	105 108	30 15	00 00	Land classification to be added (more field-work required).
73 in part.	Part of Southern California	do	17,952.24	34 35	00 40	116 119	30 15	00 00	More field-work required (land classification to be added).
73*c*	do	1 inch to 4 miles.	4,510.27	34 34	00 50	117 119	52 15	30 00	Land classification to be added.

74 in part.	Parts of Arizona.		17, 952. 24	34 35	00 40	113 116	45 30	00 00	More field-work required.
77	Central New Mexico	...do	17, 952. 24	34 35	00 40	105 108	30 15	00 00	More field-work required (land classification to be added.
80 in part.	Part of Southern California	...do	18, 301. 78	32 34	20 00	116 119	30 15	00 00	Do.
84 in part.	Part of South Central New Mexico	do	18, 301. 78	32 34	20 00	105 108	30 15	00 00	Do.
90*a* in part.	Part of Southwestern New Mexico	1 inch to 4 miles	4, 638. 24	31 32	30 20	106 108	52 15	30 00	Do.
90*b* in part.	Part of Southern New Mexico and Western Texas.	...do	4, 638. 24	31 32	30 20	105 106	30 52	00 30	Do.

RECAPITULATION.

Topographical sheets unpublished	23
Land-classification sheets unpublished	12
Geological sheets unpublished	4
Total	39

NOTE.—Geographical material has been gathered in the following atlas-sheets, but more field-data is necessary before they can be satisfactorily published, viz, 11 C, 20 B, 20 D, 28 D, 29 B, 29 D, 31 D, 38 A, 38 C, 39 C, 39 D, 40 A, 40 B, 40 C, 46 B, 47 C, 51, 56 A, 56 C, 60 C, 60 D, 62 D, 64 B, 70 B, 70 D, 72 B, 72 D, 78 C, 81, 82, 85 A, and 89.

CONCLUSION AND ESTIMATES.

On December 10, 1878, at the request of the Chief of Engineers, I submitted a memorandum exhibiting the extent, the methods, and the cost of the survey under my charge, and an approximate estimate of the cost of completing it. This appeared as inclosure No. 3 to Senate Ex. Doc. No. 21, Forty-fifth Congress, third session, extracts from which are herewith:

* * * * * * *

The survey at present is carried on at an average cost somewhat exceeding $2 per square mile, and maps of a scale of 1 inch to 4 miles result.

If land classification is to be included, not less than $2.50 per square mile should be estimated. If a triangulation of a higher order of accuracy should be required, the cost of making the same would not be less than $10 per square mile. Such triangulation, however, should not be entered upon until the information gained during the progress of the triangulations of the grades now used to establish check data for a map of 1 inch to 4 miles is sufficient to point the way. The selection of stations for the most perfect set of triangles covering this entire area can only be made with a proper degree of intelligence after the marked topographical points have been occupied as triangulation stations, and observed at with the degree of accuracy now required.

It is thought that the amount of $2,039,522.50 is the minimum of expense that should be anticipated for the completion of the survey required for a topographical map on a scale of 1 inch to 4 miles.

* * * * * * *

Since it appears that the interior topographical surveys on the European continent have cost, as in the case of Prussia, $65 per square mile as a minimum, and in England $190 per square mile for its ordnance survey, it can be readily seen how much skill and judgment should be displayed in the detailed plans for all branches of the field and office work; how much prudence in the administration and facility in the execution of so important a trust as the prosecution of a connected topographical survey of large interior areas.

The best distribution of the amount of, approximately, $2,000,000 of appropriation would be over an interval of fifteen years, somewhat as follows:

Three years, $120,000	$360,000
Three years, 125,000	375,000
Three years, 135,000	405,000
Three years, 140,000	420,000
Three years, 150,000	450,000
Total	2,010,000

Larger amounts could not be used with a due regard to economy, because of the want of skilled assistants. The number of really effective working parties can be but slowly increased, since a special field training is requisite to perfection in the application of the methods.

The plan now pursued in the topographical surveys west of the 100th meridian is to confine the parties engaged in field-work to a part or all of one of the rectangular divisions of the area, of which there are ninety-five, as shown upon the progress map.

Each of these divisions, when represented upon a scale of 1 inch to 4 miles, requires four sheets of 19 x 24 inches. The secant-conic projection employed, the co-ordinates of which are the result of original computations at the office of the survey, admits of the conjoining of the sheets, and demands uniformity in size as a prerequisite. The approximate size of the area embraced in the average atlas-sheet is 150 miles in longitude by 120 miles in latitude, or in square miles, approximately, 18,000, corresponding 11,520,000 acres.

* * * * * * *

The final topographical sheets represent mountain forms by hachures alone, or by a combination of hachures and contours.

The land classification, including arable and arid, timber and grazing, together with marked outcrops of precious and economic minerals, is similar to the expression of geological formation shown upon the topographical sheets in colors (see Annual Report Chief of Engineers, 1878, Appendix N N, p. 1439).

The land classification, as well as the topographical map, should finally be made complete for the entire area. The government will then become possessed of sufficient data by means of which to define by law a new disposition of its lands to settlers.

The main portion of the work is in advance of the subdivisions of the public lands, for the purposes of occupancy and sale; still, connection may be had with the meridian, base, and township lines of these surveys, and the true longitude and latitude of at least one given township corner to each county may be furnished the General Land Office as a check. The law might recognize the use of these points geodetically determined as proper checks in the land-parcelling surveys.

The gauging of streams at marked points of their flow is now going on, and there should be added the requirement of connecting by levels of precision sub-basins of drainage, thus to determine series of datum points to which to refer the profiles of the irrigating channels, when the same may be constructed.

As the scale of the map of the public domain may be directed to be increased at any time by Congress, it must be understood that a *pro rata* increase of expense will ensue, on account of more details as to triangulation, and for minor topographical measurements. At present more detailed topographical data is being secured at prominent mining districts, and in the more thickly settled areas, and at a cost for actually occupied square miles greater than that herein shown. The field-record forms and computation blanks in use by the survey have been adopted, after much deliberation and forethought, and exceed thirty in number. A manual of meteorological observations has been issued, and one for the geodetic and topographical observations and reductions is being prepared.

An adequate appropriation will admit of winter and summer parties, thus keeping a permanent expedition in the field until the whole area is covered.

The *personnel* engaged includes officers of the Corps of Engineers and other branches of the Army; certain technical civilian assistants and scientists; assistants enlisted in the general service; and there should also be added a number of enlisted men of the Engineer Battalion. The Washington office should be confined to the reduction of the field plots, and the issue of the maps and annual reports of operations.

* * * * * * *

Congress evidently did not consider the above estimate at that session, since in establishing the "Geological Survey," none of the duties of a topographical or geographical survey were confided to the direction thereof, but, to the contrary, the word "geographical" was stricken from the law. A geographical survey presupposes that a topographical map has been or is to be made, upon which to delineate cartographically a portion of the results. The requirement for a connected topographical map in detail of over 800,000 square miles of mountainous area, remaining unserveyed at the West, for the uses of the War Department alone, is even more apparent now than when the subject by request was laid before the House Committee on Appropriations in April, 1872; and yet at the close of the present fiscal year, for the first time since the earliest appropriation for the Pacific Railroad surveys (winter of 1852–'53), the War Department is found without money for its usual topographical surveys, as the funds of the last of twenty-eight separate appropriations made during and since that interval cease to be available after June 30, current.

It would seem that no other department, should the jurisdiction finally be lodged with it, would have the same interest in sending at an early day parties to prosecute topographical surveys in the outlying and most inaccessible parts of this great area.

As bearing still further upon the cost of this work, a copy of my letter of February 20, 1879, is here introduced, that, having been submitted by the Acting Chief of Engineers to the War Department, was forwarded and appeared as House Ex. Doc. No. 104, Forty-fifth Congress, third session:

WAR DEPARTMENT,
Washington City, February 24, 1879.

The Secretary of War has the honor to transmit herewith, for the consideration of the Committee on Appropriations, a communication received from the Acting Chief of Engineers, submitting statement in regard to the total amount expended in the prosecution of military and geographical surveys west of the one hundredth meridian now being carried on by this department.

Very respectfully, your obedient servant,

GEO. W. MCCRARY,
Secretary of War.

The SPEAKER *of the House of Representatives.*

UNITED STATES ENGINEER OFFICE,
GEOGRAPHICAL SURVEYS WEST ONE HUNDREDTH MERIDIAN,
Washington, D. C., February 20, 1879.

SIR: I have the honor to invite the attention of the department to the following remarks of the Hon. J. D. C. Atkins, chairman of the Committee on Appropriations of the House of Representatives, made while the legislative appropriation bill was under consideration in the Committee of the Whole House, in order that any erroneous impressions that might be derived therefrom shall be corrected.

The following appears as a portion of his remarks in the Record of the 11th instant, page 31:

"United States surveys and explorations west of the one hundredth meridian, Lieut. George M. Wheeler in charge, 1869–'79	$549,316

"General Humphreys does not report the salaries of officers, soldiers, and detailed men from other departments, and other sources of expenditures. If these were included it doubtless would raise the amount to over $1,500,000."

Referring to House Ex. Doc. 88, Forty-fifth Congress, second session, it appears that the One Hundredth Meridian Survey had expended up to March 8, 1878, as follows:

From Engineer appropriations	$368,770 55
Aid and supplies from Quartermaster's Department	121,348 00
Aid and supplies from Commissary of Subsistence	5,135 54
Aid and supplies from Ordnance Department	4,062 63
Total to that date	499,316 72
Amount appropriated for the fiscal year ending June 30, 1879	50,000 00
Total	549,316 72
Salaries of officers since commencement, to include February 14, 1879	66,828 13
Total	616,144 85
Amount stated by Mr. Atkins	1,500,000 00
Difference	883,855 15

The officers performing professional services, their salaries are properly chargeable to the total cost of the survey. The "soldiers" are paid the same, whether detailed as escorts upon this work or not, nor are they diverted, except temporarily, from their usual field of duty; and they do not add to the aggregate of results, but on the contrary, by the necessity of their presence, prove that the labors are conducted in the face of more than ordinary obstacles. Their expense has not, therefore, been considered properly chargeable to the work.

No men have been detailed from "other departments."

It is not known by "other sources of expenditure" to what allusion is made.

Farther on in his remarks upon the subject of surveys Mr. Atkins states as follows (see Record of the 19th instant, page 85):

"And we appropriated, I believe it was, $100,000 for the Wheeler survey, besides the transportation that is furnished to Lieutenant Wheeler by the War Department, which amounts to as much more."

The amount actually appropriated and as shown above, for the year ending June 30, 1879, was $50,000, instead of $100,000. While it is impossible to furnish the exact amount paid for transportation since March 8, 1878, as the field accounts are not yet all at hand, still the approximate amount paid by the Quartermaster's Department for this purpose, to include January 31, 1879, is not to exceed $24,000.

Instead of $200,000 for the year in question, as would be inferred, the summation of the appropriation and cost of transportation is not to exceed $74,000.

I have the honor to request that the information contained in this statement may be forwarded.

Very respectfully, your obedient servant,

GEO. M. WHEELER,
First Lieutenant, Corps of Engineers, in charge.

Col. H. G. WRIGHT,
Acting Chief of Engineers, U. S. A.

[First indorsement.]

OFFICE OF THE CHIEF OF ENGINEERS,
Washington, February 20, 1879.

Respectfully submitted to the honorable the Secretary of War.

H. G. WRIGHT,
Acting Chief of Engineers.

Independent of the great value to the War Department of constantly improving detailed maps for its current uses, the resulting advantage to its officers engaged upon these surveys lies in the experience gained with men and affairs, and in studying the *terrain* within the field of vision, from actual measurements made of roads, trails, streams, and relative elevations, thereby educating that "*coup d'oeil*" so essential to the commander in time of war, and which has been considered of great importance in foreign countries, and should not be lost sight of in our own.

ESTIMATES.

For the preparation, under the direction of the Secretary of War, of reports and maps, and such other illustrations as may be necessary in completing the office work of the geographical and topographical survey of the territory of the United States west of the 100th meridian, including cost of engraving and printing, thirty thousand dollars, to be immediately available.

To be expended somewhat as follows:

For office expenses, including pay of assistants	$19,500 00
For storage	500 00
For engraving and printing maps and charts	8,000 00
For preparation, engraving, and printing plates, cuts, photographs, and other illustrations	1,000 00
For office contingencies	1,000 00
	30,000 00

It is estimated that for filling gaps in the triangulation and topographical work, thereby admitting of the completion and publication of a number of atlas-sheets, a like amount will be sufficient.

FINANCIAL STATEMENT.

Amount expended from appropriation for the fiscal year ending July 1, 1879	$48,414 59
Amount remaining unexpended July 1, 1879, from appropriation for continuing the office work of the geographical surveys of the territory of the United States west of the 100th meridian for the fiscal year ending June 30, 1880	20,000 00

Respectfully submitted.

GEO. M. WHEELER,
Captain of Engineers, in charge.

Brig. Gen. H. G. WRIGHT,
Chief of Engineers, U. S. A.

APPENDIX A.

REPORT OF LIEUTENANT S. E. TILLMAN, CORPS OF ENGINEERS, IN CHARGE OF PARTY NO. 1 UTAH SECTION, FIELD SEASON OF 1878.

WASHINGTON, D. C., *March* 31, 1879.

SIR: I have the honor to submit the following report upon the operations of the party under my charge during the field season of 1878, together with a brief description of the country visited and a statement of present condition of office work.

I left Washington July 19 and reached Ogden on the 24th. At this point the outfits for three parties were collected. Indian troubles in Idaho prevented the field work from being conducted to the northward from Ogden, as was originally intended. The parties were organized at Ogden and transported by rail to the vicinity of the new areas selected. The area chosen for the operations of the party under my charge is in atlas-sheet 47*a* of progress map, and is situated between the parallels of 39° 50′ and 40° 40′, and the meridians of 120° 37′ 30″ and 122° 00′ 00″. It lies to the westward of and contiguous to areas mapped in 1876 and 1877.

Chico, a town on the California and Oregon division of the Central Pacific Railroad, was chosen as a base of operations, and here the supplies were collected. The party as organized consisted of myself, in charge, Mr. Gilbert Thompson, principal assistant and topographer; Mr. J. S. Polhemus, assistant topographer; Mr. Louis Seckles, meteorologist; Mr. John Bishop, odometer recorder; one enlisted man, two packers, and a cook. Before my arrival at Ogden, Mr. Thompson, with a packer and the soldier, had been sent out towards Bear Lake, for the purpose of obtaining the data necessary to complete an atlas sheet of the previous season. With the exception of that portion in use by Mr. Thompson, my outfit left Ogden on July 27 by freight. Mr. Thompson, with remainder, left on August 1. On August 8 everything had reached Chico, and on the morning of the 9th the rendezvous camp was left for the field, the party taking thirty-five days' rations.

The country to be mapped lay principally in the Sierra Nevada Mountains, but at the southwestern corner extended a few miles into the Sacramento valley. The limiting line on the west, for the greater portion of its length, fell in the foot-hills of the Sierras. Chico was a little way outside the area. In starting from the rendezvous camp it was my intention to make the complete circuit of the area, accomplishing as much as possible from a single line and obtaining a definite idea of the country. With this intention the party moved along the southern limit of the sheet until reaching the North Fork of Feather River. At this point the cañon of this stream could not be crossed and a long detour to the south had to be made. The crossing was effected at Oroville, and the stream was ascended until the original line of travel was reached and resumed. The physical features of the country caused me to abandon the idea of a reconnaissance trip around the entire area. The accompanying topographical sketch shows the lines of travel, and from the consecutive numbers of the camp the direction of the travel is known. The principal points occupied for topograpical and geodetic purposes are also indicated on the sketch.

Chico was revisited September 11 for supplies. Between the dates of leaving and return to Chico 22 camps were made and two approximately parallel lines of travel were run, extending from Chico to the eastern limit of the work. The party left Chico the second time on September 14, with 20 days' rations, and supplies for 40 days were at same date sent to Prattville by wagon Reference to the sketch will again show the lines and direction of travel, the principal topographical stations, and the places named. The party reached Prattville on September 26, and made it a base of operations from that date until October 16. On October 3, a portion of the party, under charge of Mr. Seckles, was left in camp at Prattville, the remainder operating in the direction of Lassen's Butte. The small party at Prattville made hourly readings of the barometer from 7 a. m. to 9 p. m. daily, from the 3d to the 13th of October. On October 16 the party left Prattville for the last time, taking the supplies left at that date. The general movement was thence to Greenville, Taylorville, and Susanville.

The successive camps and subsequent movements of the party are shown on the sketch, and any other remarks upon them are deemed unnecessary. Susanville was reached October 23. Camp 63, opposite Red Bluff, was made November 14, and Chico was reached December 5, where the party was broken up. The natural and physical features of the section made it a difficult one to examine with satisfaction. Nearly the entire surface is covered with timber or underbrush, which renders observation for topographical purposes, except from the most prominent points, very difficult. The lack of distinctly marked and naked points rendered it necessary to fix most of the topographical stations by observations from them, the observations to them being generally uncertain. The sketch is intended to convey an idea of the work done. The streams are pretty fully shown; the full lines are measured meandered roads; where there are dotted lines no roads existed. When such lines are along trails, it is indicated. For the reasons already given, much was made to depend upon the meandered lines Every line of this sort which would give a reasonable amount of topography was run. From the topographical stations, the usual full sketches were made. The triangulation was an extension of that of 1876 and 1877.

There were occupied for topography and located by observations on known points 50 stations; eight of these were meander stations also. There were made 5,167 meander stations, from many of which more or less extended sketches were made. One thousand three hundred and twenty one miles were meandered and 965 traveled, not meandered. Sextant altitude observations were taken at 15 camps. Observations for altitude of 135 points were made with cistern barometer and 1,129 with aneroid. The aneroids, except upon a few occasions, were compared tri-daily with the cistern. The variation of the needle was determined at 30 points.

In accomplishing the results here given, 108 days were occupied in actual field work. Stormy weather delayed the party 10 days, and 10 other days were occupied in camp transcribing and arranging collected data. In addition to the above, Mr. Thompson accomplished 9 days' field work and 2 of camp before joining the party at Chico.

The party was provided with the usual allowance of instruments, to wit: 1 sextant

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nd horizon; 1 triangulation instrument—10 inch, by Stackpole; 2 topographer's trants—minute instruments; 2 cistern barometers; 2 aneroid barometers; 2 psychromers; 1 maximum and minimum thermometer; 2 pocket thermometers.

In closing this portion of the report, it gives me pleasure to certify to the zeal, enrgy, and fitness of my assistants. Mr. Thompson has accompanied me in the same apacity for three successive field seasons. His interest in every detail of the work, is untiring energy, long experience, and familiarity with the work I have each year estified to. Whether engaged upon triangulation, topographical, or meander work, believe that he always accomplishes the best results at the least expenditure of time nd labor that his means allow. Mr. Polhemus came to the field familiar with the nstruments but unacquainted with the kind of work. He acquired with marked apidity a knowledge of the requirements of the work, and his interest and energy nade him a most valuable assistant. Owing to the capacity of these two assistants we vere often able to have all three of the topographical instruments in operation at once, nd very frequently indeed two of them were being used. The party was thus able to ccomplish far more than the addition of a single assistant would seem to imply. Mr. Seckles, in addition to the ordinary duties of the meteorologist, kept the aneroid nd odometer record. He was faithful, conscientious, and intelligent in the performnce of his work, and the full value of his services were not appreciated until his vork came to be reduced.

The country embraced in the sketch lies principally in the Sierra Nevada Mounains. The true summit line of the mountains is shown, as also the terminating line f the western foot-hills. The distinctly marked eastern wall of the mountains disppears at Thompson's Peak, near Susanville. The range is broken into numerous cones nd confusing spurs. The northwest section was once the seat of intense volcanic ction, and is dotted with ancient craters—the most marked being that of Lassen's Butte, which has an altitude of 10,400 feet, and stands 1,000 feet above any point within 75 miles. From the bordering lines of the foot-hills in the Sacramento alley long spurs of even grade extend to the northeast. The highest points of these purs form a line called the western summit. This line, so far as our work is conerned, culminates at Lassen's Butte. South of this point the western summit line is ortuous, its general direction being a little east of south. Between the two summit ines are situated several small valleys, the most important of which are the Big Meadows, Indian Valley, American Valley, Mountain Meadows, Butt Valley, Deer Creek Meadows, Battle Creek Meadows. The little town of Prattville is at the southern end of Big Meadows. There are several stores and a hotel at this place. It is largely visited in summer by the residents from Sacramento Valley, and affords a delightful change from the oppressive heat of that valley. The extent of the valley is approximately outlined on the sketch by the loop formed by the roads from Prattville around by camps 35-48 and back. Taylorville is the settlement of Indian Valley, and is at its southern point. The loop of roads from the village to camps 44-43 and return shows the extent of the valley. Quincy, the county seat of Plumas County, is situated in American Valley. This valley is much smaller than the other two mentioned. The Mountain Meadows are north of Greenville, and are completely outlined by the line of travel starting from camp 48*a* and return. Camps 41 and 18 mark the southern end of a small valley called Butt Valley. It extends 5 or 6 miles up the creek there indicated and varies one-fourth to a mile in width. An open area extending a couple of miles on either side of Longville is called Humbug Valley. Deer Creek and Battle Creek Meadows are situated near the heads of those creeks. Camp 29 is at the upper end of the first-named, and camp 58 the lower end of the second.

In the Big Meadows, Indian, and American Valleys the cereals and different kinds of vegetables are successfully grown and some fruit. Butt and Humbug Valleys and the Mountain Meadows have permanent occupants, who succeed in growing a few vegetables, but who mainly depend upon their cattle ranches. All the valleys named upport herds of cattle in summer and yield quantities of hay for their sustenance in winter. The waters from these mountain basins pass by deep and picturesque cañons o the Sacramento Valley. Along the courses of these streams, above the scorching eat of the Sacramento Valley and below the mountain snows, are situated several ich and prosperous farms. For the greater portion of their lengths these cañons are arren and desolate, and will forever remain so. The natural scenery of the region, specially around Lassen's Butte, is seldom surpassed. From this lofty cone the waters low in every direction. On its south side, at an altitude of about 7,000 feet, is situted a beautifully clear lake. From this lake, by an almost precipitous fall, the water escends for 1,000 feet. Rushing on in its downward course, it passes through a region f hot springs. The whole surface of the ground in the vicinity of these springs is arm. The cold water from above, reaching these heated points, is partially converted to steam, which in its efforts to escape sustains an almost continuous column of war in the air. In some places the generated steam is recondensed without reaching the rface, so that beneath the surface appear innumerable little jets in continual activity. The temperature of the stream before reaching this caldron is 51°: after passing through it is 85°.

The view from this point is particularly fine. On either side the lava-capped ridges rise up 1,500 feet, and to the north Lassen's Butte extends upward 2,000 feet more. Many other vents existed through which vaporized bodies made their escape. Some are still feebly active, and far up the cañon sides are seen, in variegated colors, the effect of the heat upon the volcanic rocks. From the springs there continually arises a dense column of fine white steam, which contrasts beautifully with the dark green pines, the bright earth, and sombre-colored rocks. From this point the stream, Mill Creek, continues to the southward for six miles and then turns to the westward and passes to the Sacramento through a grand cañon, reported to be impassable. On a line nearly due east from the springs just mentioned are situated several such springs, the nearest batch being upon the surface of the eastern wall of the cañon, about 1,500 feet above. Still farther to the east, and in the cañon of Warner Creek, is a large number of these springs. More to the east, and in the same line, is a hot lake, heated by the escaping steam which is generated under pressure at lower depths.

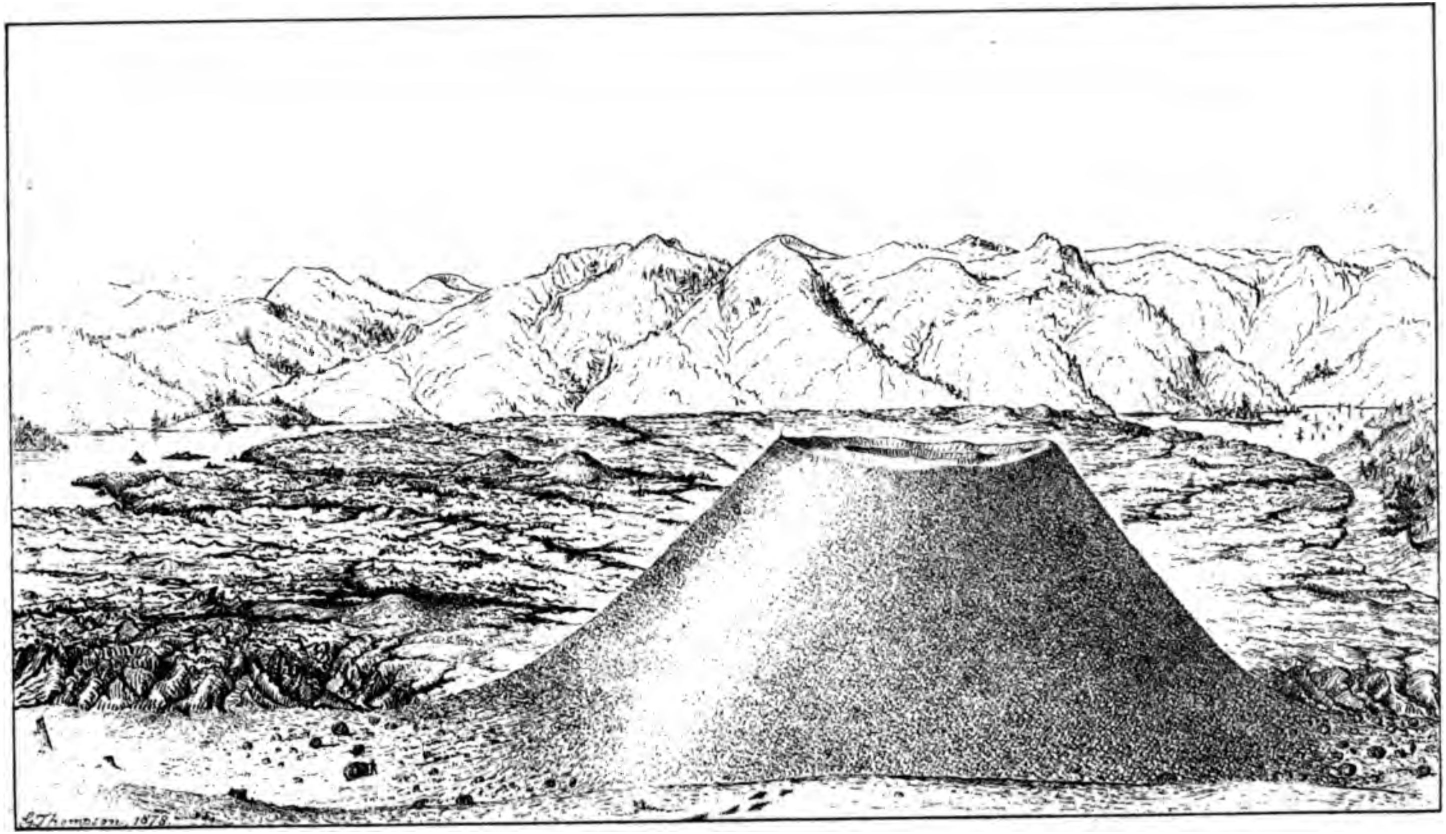
The most easterly of these springs is just north of Willow Lake on the sketch, between camps 31 and 32. This is situated at the head of a small gulch. A circular basin of about 15 feet diameter receives the percolating waters from the surrounding sides. Under this basin superheated steam is generated, which, escaping, keeps the water in continual agitation. At the time of our visit the water at one point was thrown to the height of 5 feet, the entire basin being at the boiling temperature. From all accounts, the action is continually growing less energetic. At all of these springs the action in decomposing the surrounding rocks is seen; some of them, from the continual agitation of the waters wearing away the surrounding sides, have reached a ropy consistency. After reaching this state, whenever the uplifted waters fall beyond the basin the suspended material is again deposited, so that around many of the springs little craters are built up.

Lassen's Butte is the center of this disturbed region, and, owing to its separation from other high points, is very prominent. It is easily ascended by the southeast spur. The party visited it on the 6th of October. A more fitting day could not have been chosen. It was immediately subsequent to a storm, and the atmosphere was clear and still. Mount Pitt on the north and Mount Rose on the south could be distinctly seen. Mount Shasta, though 70 miles away, did not appear half that distance. The meadows and flats of the mountain region and the Sacramento Valley were all open to inspection. Their famished vegetation lent at the distance a pleasing effect to the view. The point is itself an extinct crater, and from it many others were seen. One of these, the most recent, is worthy of mention, and is shown in the sketch. The cone is a perfect specimen. It is about 175 feet high, and is composed of black, granular cinders. The slopes are very steep—about 45°—and the ascent difficult. Upon arriving at the upper rim the interior is seen to consist of a double funnel. The larger funnel extends about 30 feet downward and then a second rim exists, which is the base of the smaller funnel. This funnel is about 150 feet deep and to the eye symmetrical.

At the south point of the circumference of the base of the cone there exists a sort of arched opening, displaying the black lava which underlies the cinders. From this point the rigid curves in the lava still show the direction of the flow, which was first to the south and then to the east. The extent of the flow is about three-fourths of a mile wide and one and one-half miles long. The field is of indescribable roughness. The flow terminates in an abrupt wall about 100 feet high. The whole mass is so rough, broken, plowed by ravines, uplifted by bubble-like protuberances, that it becomes beautiful and grand from its utter desolation. All the eastern side of the lava flow is bordered by a lake, which evidently existed before the outburst. It is divided nearly in two by the lava. Looking from the point upon which the sketch was made the whole picture is peculiarly fine. In the foreground is the cone of cinders, a perfect frustum; the lava from it spreads in bleak desolation around its base; the dark blue waters of the lake make a border around the lava; then the many shades of green from the mountain sides beyond complete the strange and weird picture. Dead trees are still standing in the lake, which probably only reached them after the eruption.

At the southwestern base of the cone are a number of globular concretionary masses, a sort of volcanic bullet, of a dark, liquorice color, containing white quartz-like crystals, probably analcime or [illegible]. A few [illegible] bushes have found root in the lava within the past ten years, but by the ordinary observer these are overlooked, and it appears perfectly barren.

The cone here mentioned [illegible] recent, but the action of many others of older date has been [illegible]. To the eastward and northward the craters are very numerous [illegible]. In [illegible] lakes. From this point [illegible] twenty-two [illegible] beauty [illegible]



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ountain valleys to the south. The valleys, flats, lower cañons, and foot-hills of this ction afford good grazing; the greater portion of the mountain region and upper foot-ills are timbered or covered with chapparal, and grass is scarce. Cattle and sheep re driven here from the Sacramento Valley during summer, and the entire area is sted to its utmost limits to support them.

The vegetation of this region has been twice described in survey reports—first in e survey for a Pacific railroad in 1854, and later, in the geological survey of California. he valuable timbers are the different varieties of pine. Near the head-waters of hico, Antelope, and the northern tributaries of Battle Creek are situated numerous w-mills. It would be difficult to find a region better suited to the production of mber. Its transportation is, however, attended with much difficulty. It is carried the valley both by flumes and wagons. The construction and repair of flumes make em very expensive, and transportation by wagon is difficult and tedious, owing to ugh roads and steep gradients. Some of the flumes are thirty miles long and in any places have to be supported by expensive trestle-work.

The general geological features of the section may be briefly stated. From Lassen's utte as a center, a vast sheet of lava has flowed in every direction. It covered nearly ll the western slopes of the Sierras, extending (as far down as Red Bluff) to the Sac-mento River. South of this point the lava did not reach to the river. The south-n point of this sheet is near Oroville. To the east the lava extended to Susanville. he limit of the flow from this point is made by a line (on sketch) passing through mps 48, 48a, 48b, 34, 42, 28, 27, 19, 21, 3, and 6. Before the western slopes of the ierras were covered by lava there was deposited a layer of conglomerate composed of agments of metamorphic rocks. In many places this conglomerate is now exposed. nd a fact which at once strikes the attent[illegible]at at the time the conglomerate was rmed the gradients must have been very different from the present. The size of the atrix stones is such as to show that with the present slope they could not have been rought into position by present causes. In some places—as between Butte and Chico reeks—the lava has not covered the conglomerate, and the sedimentary deposits are en in several layers. Beneath the conglomerate, Tertiary and Cretaceous beds were xposed in some of the cañons. Granite appears along a line from camp 5 to 6, and om camp 9, along a line, to Greenville. It also appears in the vicinity of camp 45 nd is exposed in a narrow belt from that point to the southeast.

South of Greenville there is a quartz mine in operation, which I visited. The super-tendent was unwilling to give any information in regard to the mine, but referred e to the owners in San Francisco. There is another mine in the same vicinity in peration, but it was not visited. Copper and iron ores were seen in the vicinity of amp 45, and prospecting is carried on in the granite ledges extending from that point long the line above indicated. Hydraulic mining and prospecting have been exten-ively attempted between camps 5 and 6. Sedimentary rocks of the Pliocene period ake up the remainder of the exposure of the section embraced in the sketch. Around assen's Butte the evidences of glacial action are very distinct and beautiful. To the orth and east of the butte the lava covering is continuous. The more recent flows an be easily distinguished from the older. In one place along the old emigrant road, orth of Lassen's Butte, the lava crust has broken in, exposing an immense arched avern. It would seem that the upper surface had cooled while the interior was still quid. This liquid subsequently flowing out left the opening. Far down on the estern slopes of the mountains are situated several extinct craters. The lava-fields om Oroville to the north are principally hard basaltic lava with occasional layers of shes and scoriæ. Lassen's Butte is a magnificent mass of trachytic *débris* with pro-cting ledges of the same. It was once a crater. Rhyolite is found at the south and astern base of the butte, which at a distance closely resembles gneiss.

It is well known that it seldom rains in this section between May and November. t the time the party left Chico, August 8, the Sacramento Valley was oppressively arm, parched, dusty, and disagreeable. The day temperature frequently exceeded 00°, while the night temperature was 30° to 40° less. The daily range in the valley as not so great as in the mountains, though the daily maximum and nightly min-mum of the valley were both greater. The valley of the Sacramento, as viewed from e mountains between August and December, is generally enveloped in haze. This aze is so much thicker in the valley than above that it is outlined like a wall both orizontally and vertically. It was a source of much trouble in topographical and eodetic observations. The obstructions to the work from this cause, from the timber, nd from the long, deep cañons, made the area difficult to map with accuracy.

The accompanying sketch is intended to render intelligible the movements of the arty, and give an approximate idea of the labor bestowed in the work. I am in-ebted to Mr. Thompson for the topographical sketch, as well as the drawing of vol-anic cone herewith.

In conclusion, I would refer to the obliging kindness of General H. B. Davidson, gent of the Central Pacific Railroad at Chico. His disposition to assist the party reatly facilitated our preparations, and saved me great personal annoyance.

After reaching Chico, on December 5, the party was disbanded. The material and animals were taken to Sacramento. I was detained at this place until the 18th of December, in connection with the disbandment of the parties of Lieutenants Macomb, Young and Ludlow. On the 20th I arrived at Ogden, at which point I remained eight days, under your instructions, for the purpose of starting a field office at this point. On the 28th I left Ogden for Washington, and arrived here on the 2d of January.

OFFICE-WORK.

Upon arriving at the office I was directed to superintend the reductions of geodetic, topographical, and hypsometric observations. As usual, the amount of work in these reductions has been very great. In the geodetic branch Mr. Miles Rock is the first assistant. At the time of my arrival he had the work well under way. He has practically had charge of its execution since, seldom receiving any advice from me except as to order of sequence. He has selected and arranged the figures for adjustment, and been employed principally upon the computations for adjustment. His thoroughness, great care, and perfect system are all that could be desired in such work. For the management of this branch of the work he deserves and should receive the principal credit. In this branch the other assistants have been Mr. J. S. Polhemus, Mr. C. J. Kintner, and Mr. William Hoffman. Mr. Polhemus commenced the work upon his return from the field, and has been continuously engaged upon it since, having had experience in every step, from the adjusting of angles to the final computation of positions. He has been very regular in attendance, careful and systematic, and perfectly satisfactory as an assistant. Mr. Kintner was employed temporarily, and was engaged in the adjustment of figures and subsequent computations. He brought his previous experience to and displayed his usual rapidity in the work and greatly facilitated the reductions. Mr. Hoffman's services were secured about the middle of January and retained since. He has taken part in every step of the reductions, from the station adjustment to the determination of the final position, and his work has been satisfactory. Dr. A. Einhorn was also employed a few days in this branch of the work. In the meteorological branch Mr. F. M. Lee and Mr. F. W. Floyd and Mr. John Hasson have been the only assistants. Mr. Hasson was employed only temporarily. Mr. Lee has been engaged entirely in the arrangement and computation of observations from the cistern barometer, and Mr. Floyd entirely in the computation of aneroid profiles. These gentlemen are neat, careful, and conscientious in their work, and it is sufficient commendation to call attention to the results as below stated.

In the geodetic branch at the time of writing (April 15) there have been computed the positions of 46 primary triangulation stations, 30 secondary triangulation stations. 31 cross-sight stations, 120 three-point stations. In the meteorological department there have been computed 805 altitudes from cistern barometer observations. 5,413 from aneroid observations.

Very respectfully.

S. E. TILLMAN,
First Lieutenant Corps of Engineers, U. S. A.

Capt. GEORGE M. WHEELER.
Corps of Engineers, in Charge.

APPENDIX B.

REPORT OF LIEUTENANT T. W. SYMONS, CORPS OF ENGINEERS, IN CHARGE OF PARTY NO. 1. CALIFORNIA SECTION. SEASON OF 1878.

UNITED STATES ENGINEER OFFICE AND OBSERVATORY.
Ogden, Utah, March 31, 1879.

SIR: I have the honor to submit the following executive and descriptive report of the operations of the party under my charge during the field season of 1878.

I arrived at Carson City, Nev., on the 12th day of July, under orders to organize there for the field two topographical parties and one geological party. Owing to delays in forwarding supplies and assistants from the east, it was not until the 29th day of July that I was able to leave Reno with men and instruments to rendezvous at Camp Bidwell, where I arrived August 1. August 4, our stores arrived, and on the 7th. everything being in shape, we started for our summer campaign with the following *personnel* and outfit: Lieut. Thomas W. Symons, Corps of Engineers, executive officer and field astronomer; Charles P. Kahler, topographer; Thomas W. Goad, meteorologist and assistant topographer: H. W. Henshaw. naturalist: Richard Pitcher. odomter recorder; French, Sayres, Collins, and Barrett, packers; and Willson and Hen- erson, cooks.

Our transportation consisted of 11 riding mules, 16 pack-mules, 7 extra mules, and bell-mare and colt. A full set of the instruments, books, &c., necessary for our ork was furnished. Our instrument for taking azimuths was, however, too old and orn to be reliable for that purpose. It was my intention, if possible, to carry a sys- em of triangulation across from the mountains occupied in 1877 by my party, in the icinity of Surprise and Warner Valleys, in a northwesterly direction, to the high eaks of the Cascades. This I found to be entirely impossible in the time at my dis- osal, owing to the dense haze which prevailed almost uninterruptedly from the time f leaving Bidwell until we reached the vicinity of Mount Jefferson, in the fall.

The people of the country inform me that it is generally very hazy during the sum- ier in Oregon, but that for some reason it was much more so this summer than ordi- arily. This haze must be attributed mainly to the fires in the woods and swamps, of hich great numbers came under my personal observation, and these formed but a nall part of the existing ones. Besides those which occur from unexplained causes, reat numbers of these fires are built by the Indians for the purpose of driving game ito places convenient for their slaughter. They also burn off the marshes in the lat- ir part of the summer, that a more tender and nutritious grass may grow for their onies. The haze is also very largely attributable to the impalpable dust which rises om the desert. The winds grind the dry, cinder-like vegetation of the great arid lains and mountains to atomic fineness, and then, carrying it aloft, it mingles with ie smoke and forms the impenetrable clouds which so seriously impede the work of ie surveyor.

Our first station after leaving Camp Bidwell was Sugar Loaf Mountain, a triangula- on station of the previous year. Leaving this we went around to old Camp Warner, id then moved to the north. On Rabbit Creek we found a deserted cabin, and quite large number of cattle and horses which had undoubtedly been deserted by the owners ir fear of the Indians who had devastated portions of Warner Valley, only a short istance away.

Bidding adieu to Rabbit Creek and its myriads of little scampering inhabitants from hich it takes its name, we crossed a range of hills where bunch grass and springs ould furnish food and drink for many cattle, and then on to the north across the great rid rocky plateau lying to the east of Abert Lake. So rocky and barren is this great lateau that not a living thing was seen during our journey across it. In the distance e could see the outlined mass of a mountain, which guided us and which I wished to ccupy if the haze should diminish sufficiently. Arriving near it toward nightfall we pread out in search for water, but the hillsides and ravines, so far as we could find, ere as innocent of water as are the mountains of the moon. After traveling some time ito the night, we found a place where a little water could be dipped up from about ie roots of the tules, and here we made camp and passed a night made hideous by the ites and songs of myriads of mosquitoes, the wailing cries of the coyotes, and the ifling atmosphere.

As early as possible in the morning we moved out to the westward, and after travel- ig several miles found a beautiful spring in the northwestern part of the valley, where ien and animals slaked their raging thirst, and then keeping on to the westward over rolling sage-brush country utterly desolate and waterless, we at last, at nine o'clock the evening, reached Chewaucan marsh and camped on the banks of the Chewaucan reek.

This marsh or valley is divided into two parts very similar, and separated by an in- rvening range of hills, except at the low place where the stream breaks through. hey are both low and marshy, and overflowed in the spring, and while a small pro- ortion has been reclaimed, by far the larger part is still a tule and marsh grass flat, irnishing a good winter range for cattle that live on the hills in the summer. The hewaucan flows through these two divisions, not as a stream, but by being dissem- iated through them to form the marsh, and then leaving as a creek to flow into the outh end of Abert Lake, which is its sink. Some ranches have been taken up and orked where there are streams coming down from the mountains and about the upper nd of the northern marsh. I cannot but think that there is a very prosperous future or this valley when capital and enterprise are found to make the necessary improve- nents for reclaiming the entire valley, which can be done by turning the stream and orming an irrigating ditch of it along the base of the mountains which constitute the restern boundary of the valley. This would drain the swamps and furnish water for rrigating the reclaimed and the now arid and waste land between the swamps and the iountains.

The creek discharged when we were there in the dry season, in the middle of August, bout 26 cubic feet of water per second, an ample sufficiency for every purpose. It ses in the mountains to the west, is full of the finest trout, and about its sources ousands of cattle find abundant summer range. Timber is plenty and within easy stance, and a saw-mill is in operation on the divide between this valley and Goose

Lake. Any one visiting this valley in a few years will, I believe, find it inhabited by many hundreds of people.

Leaving Chewaucan we proceeded to the north over a low barren divide into Summer Lake Valley, and kept on up the western side of the valley to Foster's ranch. This lake is of bitter alkaline water, entirely unfit for use except as a goose and duck pond. It is, I believe, strongly impregnated with borax, but am unable to say, as the water collected has not been analyzed. Most of the fertile patches along the lake are taken up and under cultivation. I am informed that the climate in this valley is much milder in winter than it is in any of the neighboring valleys, and can well understand why it should be so, for all the west shore of the lake, which is the only part inhabited, is shut in on three sides by the almost perpendicular cliffs of the Rim-rock Mountains, and consequently none, or at least very few, of the chilling winds of winter can reach it, while the lake on the east acts as a great heat reservoir.

As it continued uninterruptedly hazy, I gave up all attempts to carry any triangulation across to the Cascades, and, leaving Foster's, struck out for Klamath by crossing the Rim-rocks by the old Frémont Pass, and moving westward through the timber until the Sykan Marsh was reached. This, at the time we visited it, appeared a level meadow about fifteen miles long and ten miles broad, covered with splendid grass. A fine stream flows through the valley, with its banks bordered with tall willows and its waters enriched with great numbers of large brook-trout, of which several were caught, weighing from four to six pounds each. I was subsequently informed that the whole place is flooded in the spring and remains covered with water until June. The water has for its outlet the north fork of the Sprague River, and in the years past has so dammed up the outlet at the southern end of the valley by alluvial accumulations that at high-water in the spring the overflow is caused. The remedy is easy and unquestionable, by which the whole place may be reclaimed. It is the same action that has taken place in Goose Lake, whereby its outlet into Pitt River has been destroyed. This valley lies partly in the Klamath Indian Reservation, but the Indians seem to make no use of it at present.

Leaving, now, the southern end of this pretty valley, we proceeded to the southwestward, in the direction of Fort Klamath. Our way lay through the unbroken forests of pine, tamarack, cedar, and spruce; the soil of volcanic sand and ashes so light that at each step our mules sank into it above the fetlock joints. Every now and then a tract would be encountered which had been swept over by fire and hurricane, covering the ground with a network of charred and dead trunks, making progress doubly difficult and tedious. No grass and no water exists in these sterile wastes except little widely scattered patches and springs, and it was with great joy, after being for several days in these woods, that from the summit of a divide we came in sight of the Cascades, and knew that for the present our weary plodding through the deep and untrodden sand was nearly over.

Soon we came to the old Oregon Central Military Road, and continued on down it until we came to the Sprague River, thence down this noble river and across its tributary, the Williamson River, to Fort Klamath. Both the Sprague and Williamson Rivers have considerable bottom lands, which are now going to waste, for the Indians feed but few ponies on them and cultivate but an infinitesimal portion of the soil. Flowing over pebbly, rocky, and sandy bottoms, and with banks bordered by great pine barrens or beaver-inhabited cottonwood bottoms, green meadow lawns or willow clumps, the streams of this vicinity are the most beautiful in the world. Nothing could be more pure and clear than the waters of the Sprague and Williamson Rivers and Fort, Wood, Annie, and the other creeks about Fort Klamath. All the streams are stocked with fish, nowhere else to be found in such abundance and quality. Trout of from three to fifteen pounds and sometimes larger are taken in these streams.

At Fort Klamath the outfit was divided, and Lieutenant Wheeler and his party set out northward along the base of the Cascade Mountains to the Columbia River, while I with five men went south to Mount Pitt, thence north to the Columbia, occupying as I went the high peaks of the Cascades. Going around by Spring Creek, Pelican Bay, the Dead Indian Road, and Rancheria Trail, we camped at Four Mile Lake, and the next day started to make the ascent of the peak, intending, if possible, to go up it by the long ridge which juts to the south.

After spending most of the day in picking our way through the labyrinth of fallen timber and beds of rock, we were completely stopped by great lakes of lava bowlders across which we could not go with our animals. We returned to camp, and after one more day spent in vainly endeavoring to penetrate the maze, on the third day we succeeded in climbing the peak, taking our animals to within about 500 feet of the top, where we camped among rocks so thick that we could not find a place to attain a comfortable position.

The next day we occupied the peak, and took such observations as the smoky nature of the atmosphere would allow.

Mount Pitt, or Wal-um-sen-yein (Rogue River Mountain), as the Indians call it, from the fact that it is the highest summit about the headwaters of Rogue River and its ributaries, is the most southern peak of the Cascades and a very beautifully shaped one-like structure of volcanic rock. Wherever the slopes are not too great and it is a ittle sheltered, the mountain is covered about the summit with great and thick masses f snow. The ascent is extremely difficult and perilous, owing to the great rock slides which it is necessary to cross and sometimes to climb. From the summit the view is ery grand and extensive. To the north the snowy range of the Cascades, sharp and agged, extends until lost in the distance. It is flanked on both the east and west by numerous outlying spurs and foot-hill ranges. To the south the various mountain anges of Northern California are seen in wild confusion; while towering high above ll, Mount Shasta shows itself clear and white. To the west we overlook the fertile alleys of the Rogue River headwater streams, with their intervening mountains and hriving towns, while to the east the main features of the landscape are the Klamath akes and marshes and hills of no great height. Woods are all around us as far as the ye can reach, covering every hill, bordering every lake and meadow—woods of yelow, black, and sugar pine, of tamarack, spruce, and fir, and impenetrable jungles of brush. Spread around us are many pretty mountain glacier lakes and meadows.

Leaving Mount Pitt, we retraced our steps to Klamath, and from thence started into he wilderness to the north, our first objective point being Mount Scott, the next high peak of the range. Our method of proceeding was to make as accurate as possible a time meander from one camp to another, and from camps to peaks and return; to make topographical stations on mountains and hills whenever practicable; to take sextant time and latitude observations at each camp, to make cistern and aneroid observations for altitudes at short intervals, and to connect our work by triangulation through to the Columbia River as well as the limited time at our disposal admitted. This latter part of the work was rendered impossible by the smoke and haze and the necessity for haste which my orders demanded.

The soil over which we traveled is composed of volcanic sand and ashes interspersed with basaltic bowlders, and with here and there an exposure of trap-dyke. Lumps of ashy conglomerate without grit abound, which can be worked into any shape and furnish an excellent powder for cleaning purposes.

We were continually in the forests of pine, except when we crossed the western arm of the Great Klamath marsh or traversed some little glacier meadow or tract of fallen timber overthrown by fire and wind. It is extremely hard traveling through this country, the soil being so light and loose that our mules sank fetlock deep at each step.

Mount Scott has the same general features that characterize most of the Cascades. It is of volcanic origin, and is covered on the eastern side with the ashes and light *débris* which have been carried over from the west and form a comparatively easy slope to the summit. On the west the bluffs are almost perpendicular walls of igneous rock, ragged and torn, among which nestle great masses of snow sheltered from the summer suns, and forming reservoirs of water which irrigate beautiful patches of green in the lowlands at their feet. To the southwest, following down these walls, we come at last to one of the most remarkable and interesting features of nature's handiwork that is to be found. In the calm stillness of an exquisite summer's day, lying there in the dense and lonely wilderness, we saw Mystic Lake, a great elliptical shaped basin of water about eight miles long by five wide, with walls of unbroken cliffs from 1,000 to 2,000 feet in height crowned with evergreens and pines. A little conical island near the center, with scattered trees upon it, is the only occupant of this weird lake. There is probably a subterraneous outlet of the lake in Sand Creek, which flows to the east and is absorbed in the waters of the Great Klamath marsh system. Many other lakes are to be seen in the neighboring regions, and interesting bits of scenery hidden away in the woods and hills.

Leaving Mount Scott, we proceeded northward, skirting along the eastern base of the mountains, passing on our way Mount Thielson, its summit peak in the shape of a cow-horn, and reaching, on the 14th of September, Diamond Peak, another of the typical high mountains of the Cascades. I ascended this peak and remained on its summit several days, but was precluded by the smoke and storms from making any good station.

In traveling from Mount Scott to Diamond Peak, we passed the divide which separates the waters of the Klamath system from those of the Deschutes and Columbia. The Deschutes drains all the eastern watershed of the Cascades from the latitude 43° 10′ to the Columbia, and by means of the Crooked River a large portion of the great interior basin of Central Oregon.

Odell Lake lies to the east of Diamond Peak and is the cradle of the West Fork of the Deschutes, being supplied by the melting of the great snow fields and glaciers about the eastern portion of the Diamond Peak cluster. It is a very wild, romantically-beautiful sheet of water, in size about five miles by four. There is no grass on its borders and the fallen timber and dense thickets of brush and tamaracks, and the miry bogs, made it impossible to reach the shore with our animals, and we were obliged to retrace our steps for some distance and camp on the supply stream of the lake, where our mules fared very badly, as, indeed, they had done most of the time that we were in this timber-covered country.

With infinite labor we progressed slowly on to the northeast; all we could do was to make about 5 or 6 miles per day, so dense were the forests and thickets, so soft the soil, so steep the hills, and such intricate masses and tracts of fallen timber blockaded our way. Climbing one day around the brow of a hill, we came in sight of another lake, cliff and tree environed, and with bottom lands and meadows of great extent, with what appeared to be mud-flats near the water. This lake and valley were about 12 by 6 miles in size, and took us completely by surprise, as they were evidently in the course of our West Fork and were not represented on any map. Reaching it we found at its southern end many acres of rich grass and bunches of tall willows. Following around the west shore to the northern end, we ascertained that there was no visible outlet. We saw the water-marks 20 feet above us on the lava-bluffs of the northern and northeastern shores, and camping beside these in the night we heard strange rumblings in the vast pile.

We found the next day that these lava beds formed an impassable barrier extending unbroken for about 4 miles to the north, and at their end we were again surprised to find, foaming out from underneath the giant bowlders the clear, cold river that we had seen lose itself in the lake 15 miles and more to the south. All was now plain to us. The masses of lava had been deposited in their present position by some tremendous convulsion of nature, forming a dam to the waters and thus making the lake and green grassy valley where before there was none. The noises of the night were caused by the water forcing itself through the interstices of the rocks and wearing them and causing them to tumble upon one another. The water-mark 20 feet above us shows where the waters rise in the spring, when the mountain torrents are swollen. This explains also why we found the valley unsettled, as it is overflowed the greater part of the spring and early summer. It cannot be many hundred years since the convulsion took place which resulted in the formation of this singular lake and valley, called Davis Lake by the few people who know of its existence.

Following on down the river, through the great forests of pine, now and then cutting across a bend, and often crossing tributary streams which bring the snow waters from the Cascades, seeing little land of any value for agricultural or grazing purposes, seeing deer in great numbers, and signs of other large game, we came to the Spring River, another specimen of nature's grand way of doing things. The source is a spring covering acres of ground and sending down to the Deschutes its waters in a stream 200 feet wide and 2 to 4 feet deep. The Three Sisters and their mountain neighbors must furnish the water which pursues its hidden way and rises at this great spring.

On the 22d of September we reached Farewell Bend, at which point there is a ford across the Deschutes. The river here is about 400 feet wide, running very swiftly over a rocky bottom, with a nearly uniform depth of about 2 feet. There are some very pretty meadow bottoms along this portion of the river. This has been a crossing-place for many years, and receives its name from the fact that the emigrants going north, east, or west in the olden anti-bridge times here bade farewell to the river.

From here we marched 27 miles to Crooked River, going by the old emigrant road. Our way lay all day along a rocky sage-brush desert, with junipers scattered more or less closely all over it. It was a great relief to emerge from the woods in which we had been traveling almost continuously for over a month, where our vision had been so contracted, out into the open country where the broad plains were spread out before us as far as the eye could reach. This plain across which we traveled presents the most unmistakable evidence of having been covered with a flow of molten lava from the mountains to the west of us. It is easy to distinguish the wave fronts where the fiery mass was arrested in its course by the hardening of its elements, and which enables us to imagine these hundreds of square miles as once a seething, struggling, turbid lake of fire.

At Crooked River I found Lieutenant Wheeler and his party, and separated again from him to rejoin the party at Warm Springs Agency.

In going from Crooked River to the Warm Springs Agency I did not follow the road, but struck across the country, intending to camp on Willow Creek. It does not do in this western country to expect too much, even to expect to find water in a creek, as to our discomfort we discovered on reaching Willow Creek that evening. We made a dry camp among the junipers, and consoled ourselves with a great fire. The next day we reached and crossed the Deschutes, after descending into its cañon fully 1,000 feet below the plain we had been traversing. Over this plain the bunch grass grows in great luxuriance, but there is very little stock upon it, owing to the scarcity of water. While encamped on Crooked River a storm in the mountains covered all the peaks with snow and cleared the atmosphere, and on our way to the agency we were greeted with a prospect the grandeur and beauty of which it would be hard to surpass. The great heights of Jefferson, the Three Sisters, Diamond Peak, and all the lesser mountains of the range, loomed up in their new and fresh robes of snow, pure white against the clear, blue sky, with their skirts of woodland showing folds and creases where sunny hill-slopes and shady cañons branched from the parent mass.

The exquisite beauty of this day's march will, I hope, never be obliterated from my memory.

The grand cañon of the Deschutes in this vicinity is about 1,000 feet deep, with walls almost perpendicular and impassable except at points quite remote from one another. All the country seems to be metamorphic in its upper strata and lacustrine or marine in the lower. To the west the country is considerably broken up into cañons and ravines, made by the streams coming down from the mountains. The Warm Spring Indian Agency is situated on one of these streams about a mile from the Deschutes.

Leaving the agency with an old Indian chief, Clem-tusch-na, as guide, I started for Mount Jefferson, which has never been ascended. The mountain was enveloped in clouds, and after experiencing a driving rain for two days, we retraced our steps, as we judged that it would be impossible to make the ascent over the loose snow which had fallen during the past few days upon the mountain. Indians out hunting came in with the information that the snow was 2½ feet deep at the base, which convinced me that it was too late to make the ascent of either Mount Jefferson or Mount Hood, as I had intended doing.

Leaving again the agency, we moved to the north over the rolling, cut-away mesa country, and at about 8 miles distance came to the Warm Spring River, upon which we found quite an encampment of Indians, lolling about in listless idleness in the pleasant, warm weather. At the Warm Springs, about an eighth of a mile from the village, there were a number of Indian women disporting themselves in the basin which had been hollowed out for the purposes of the bath. The cañon of this creek is very deep, and over the hills and down to this place, which is the winter home of the Warm-Springs, many trails lead. About the cañon and on the hills many horses were grazing, and some few cattle, but the latter were in nearly every case poor and scrawny, although the feed was excellent, and this I attributed to the lack of salt. Hence we kept on our way over a country which commenced to give evidences by its vegetation that we were approaching more nearly to the sea-level and a more moist condition of the atmosphere, until we came to Oak Grove, a stage station and store, where the road debouches from the Mutton Mountains into the plains or valley called Oak Grove. Here I found the rest of the party, and sending Mr. Karl to survey the new road which leaves this valley and joins the Barlow road and crosses the mountains to the south of Mount Hood, I, with the main party, kept on across the plains of Oak Grove to Tygh Valley. This plain has several valley settlements in it, the most notable being the Womack settlement and that around Wappinitia, the main post-office of the valley. It is quite well covered with grass, and is being rapidly settled up, as it has been pretty thoroughly demonstrated that crops of cereals, potatoes, and fruits can be raised in this country without irrigation, and water enough for domestic purposes can be obtained by sinking wells.

From this plain we descended into Tygh Valley, which is at the bottom of the old cut made by the White and Tygh Rivers. It lies about 500 feet below the Oak Grove plain, and is a level, pretty valley, some ten miles long, and averaging about one to one and a half miles wide. The White River, with its whitish muddy waters, breaks out of its rocky, clear-cut cañon into the valley, and is joined by the Tygh Creek, the two forming a considerable stream, which at the east end of the valley flows into the Deschutes. Before, however, reaching the Deschutes it runs over a precipice, forming a very pretty waterfall, where Mr. Sherar, the most enterprising business man of the region, has built and is running a fine flour mill. From Tygh Valley to The Dalles the distance by the road is about thirty miles, and leads over a succession of hills and ridges, gradually diminishing in altitude until the Columbia is reached. In this region there are several streams of water, but as they run in deep cuts, the water is only available for irrigation on the lands at the bottom of these cuts, and it has until within a year or so been considered that all the land of these rolling hills was useless for agricultural purposes. But within a short time different ideas have prevailed, and now farmers are rapidly settling up the country and raising good crops. And it is claimed that better crops of grain can be raised on the hills than in the bottoms.

Our first view of the Columbia was very disappointing, for looking down upon it from the hills above The Dalles it appears a very small stream, winding its way through the rents of a great bed of basaltic rock, while to the north were the great dry, barren-looking Klikatat Hills; and in the nearer foreground the rocky flats, partially covered with dunes and heaps of drifting sand, marked a very picture of desolation. Below and at The Dalles, however, the river widens out nobly, and its waters are breasted by the steamers of the Oregon Steam Navigation Company, which has also built a railroad around the unnavigable portion of the river above The Dalles, from the latter place to Celilo, whence others of their boats carry passengers on up the river.

The Dalles is the most important town of Oregon east of the Cascades, the county seat of Wasco County, and is situated at the head of navigation of that portion of the river between the Cascades of the Columbia and the narrows above the town. This is the grand *entrepôt* for all the great interior basin of Oregon and for a large part of Washington Territory, and it is safe to assume that there are more than 40,000 square miles whose white inhabitants draw their supplies almost exclusively from The Dalles. This assumes a large forwarding business, continually increasing, which is entirely done by wagons. The town is well supplied with water from Mill Creek. The population is about 1,500 souls.

At The Dalles I found an astronomical monument which had been erected and its position determined by Mr. Clark, and in obedience to instructions I set about the work of finding and measuring a base line and developing it. I selected a base extending from just west of the burying-ground, near the old mission, to a point in the race-course, about one and three-fourths miles in length. This was carefully cleared away and measured, but as we had no standard rods to compare our tape, it had to be sent to Washington to be compared there as we used it. There being no good natural points in the vicinity, I developed the base to the Klikatat Hills, previously building monuments upon them about twelve miles apart on the two highest. These hills lie just north of the Columbia River, with a narrow belt of bottom land intervening. They are covered with bunch-grass, and some fine springs exist, which, however, do not furnish water enough for the great number of cattle and sheep that could find sustenance thereon. Beyond these hills lies Klikatat Valley, through which runs Klikatat River, discharging its water into the Columbia several miles below The Dalles. This is a very fine valley of many miles in extent, and studded over with houses and claim shanties. Away to the north, at the foot of the wooded hills, lies Golden Dale, the valley town. All the supplies of the valley are procured at The Dalles, and all products find a market there. The rivers and the hills form a great drawback to the valley, as to get to The Dalles it is necessary to cross the Columbia on a ferry-boat, to which the legislatures of Oregon and Washington Territory have given the right to charge exorbitant prices for services performed, and also to cross these hills by a winding road which ascends some 3,000 feet in about ten miles, and descends in about the same distance.

While engaged on the base measurement, one party under Mr. Karl was kept at work doing topography about the vicinity of Mount Hood, both south and north of the peak. On the 27th of October we had finished measuring the base. The azimuth taken here is not to be relied on, as the instrument used was old and unreliable, and unprovided with an axis-level.

On the 29th, Mr. Kahler, Mr. Goad, Collins, and Condit started on their return to Bidwell, by the Cañon City road to old Camp Watson, across to the Harney road, and via Warner Valley. An account of the trip is appended. On the 30th Mr. Henshaw left us to return to Washington, and we left The Dalles and marched along the river-road to Miller's Bridge, which crosses the Deschutes near its mouth. The town of Celilo lies just below the mouth of the Deschutes, on the Columbia, and is the eastern terminus of the railroad from The Dalles and the landing place for the Oregon Steam Navigation Company's steamers which ply up the river. From the bridge, which is a strong, well-kept structure, we proceeded up the Columbia by the wagon-road until opposite Columbus, where there is a ferry. Here we left the road and went over the trail along the bluffs. This is an excellent type of a good Indian trail, very picturesque and well selected. We camped at Grant's Landing, and made a station on the highest peak of the Klikatat Hills, opposite Celilo. The hills are covered with grass, but water is lacking.

From Celilo we turned southward, traversing the section of country lying between the Deschutes and the John Day Rivers. From the great bend of the John Day at Bridge Creek the river runs nearly due north, as also does the Deschutes, the two rivers forming the two sides of a parallelogram about seventy miles long and thirty miles wide. The cañons of both rivers are very deep and steep, and the land rises into roundish hills with intervening ravines and lowlands. The soil of nearly all this section is excellent, and is covered with a luxuriant growth of bunch-grass. Unfortunately, there is a great lack of water, which will hinder its speedy settlement very much. These hills are bare of timber, and and are called haystacks from their shape and their covering of grass. At Grass Valley, where there is a little stream, a settlement is forming, and water is very easily obtained by digging a short distance. We crossed the Deschutes again by Sherar's Bridge, at the lower end of Tygh Valley, being obliged to go by way of the Mutton Mountains and the Warm Springs Agency for supplies. Some idea of the difficulty of crossing the Deschutes and the depth o[illegible] its cañon is shown by the fact that we descended constantly, by a well-graded road through side cañyons for a distance of six miles before reaching the bridge. He[illegible] Mr. Sherar has constructed a very ingenious little fish-trap for taking salmon, which h[illegible] preserves. Near the bridge there are some little falls, and a small rocky island jus[illegible] above the falls separates the channels forming the falls and a little side chute muc[illegible] easier of ascent for the fish than the falls. At the head of this chute he has made [illegible] trap which receives the fish and forces it to find egress through a flume whic[illegible] gently conducts it to the fish-house, from which it only emerges after being killed an[illegible] salted.

After working several days among the Mutton Mountains, we returned to the agency and laid in a supply of provisions for our trip to Camp Bidwell. We all received much kindness at the hands of Captain Smith, the Indian agent, and his assistants, and I wish to bear testimony to his great success in the management of the Indians and their advancement in the arts and customs of civilization. From a state of savage degradation he has in a few years taught them to build and live in houses, to cultivate the ground with improved agricultural instruments, to provide in proper season for future wants, to wear ordinary clothing, to respect age and womanhood, to attend the religious exercises, to learn trades, and to dispose of their ponies and purchase cattle. A good school is in operation. Some of the children show a very considerable aptitude for learning. These remarks apply mostly to the Wasco tribe, on whose particular domain the agency is situated. The Warm Springs are still in much more of a state of nature, living in wigwams of skins or cotton, and subsisting chiefly by hunting and fishing.

Leaving the agency, we crossed again the Deschutes by the Indian Ferry and bade farewell to this beautiful river. Traveling on by the settlement at Willow Creek we crossed by the road to the mouth of Grizzly Butte to Prineville, a thriving town situated at the junction of Ochoco and Crooked Rivers, and in the midst of a stock-raising and agricultural district. Several good stores, mills, shops, &c., are here, and it is growing rapidly. After remaining here one day we started in a drizzling rain to cross the desert to Silver Lake. Our first day's march of 26 miles brought us to Green's Ranch, where we had plenty of good water, wood, and grass. I could not resist the temptation to remain over one day and hunt in this vicinity, where the mule deer is so plenty. We were rewarded by having seven deer in camp at night. This desert country, especially the mountains and hills about Bear Creek and the Bear Creek Buttes, is the great winter range for the deer of the Cascades. Leaving Green's our next watering place was Laughton's, to reach which we traveled two days, making a dry camp at night. The water here is very scant and poor, and has to be dipped up with a basin from a deep hole in the ground.

Our next camp was on Christmas Lake, at Button's Ranch, and from here we marched to Silver Lake, and the desert was crossed. We passed at Button's within a short distance, about eleven miles, of the sandy desert where the petrified animal remains have been found, and at the ranch we secured some fine specimens. The desert that we crossed is in some places rocky and in others has a scanty growth of grass and sage-brush and some junipers on the hills; taken as a whole, it is about as worthless a country as it is possible to find. It extends from the Cascades to the Rocky Mountains, with a width of from 100 to 200 miles. This vast area is crossed by several rivers, has some streams, sinks, and springs, but on the whole is a very desolate country. We were glad to get to Silver Lake and among the settlements again. This lake is a fine fresh-water sink, fed by Bear, Bridge, and Silver Creeks, bringing down the water from the mountains to the west. Around the lake there are a goodly number of ranches, especially about the west and northwest in the bottom lands traversed by the above-mentioned creeks. The road for the south leaves Silver Lake, and passing over a rough rocky dividing range of hills descends into Summer Lake Valley, and continuing on down the west shore of the lake it crosses over into Chewaucan, and down this valley, and crosses the dividing ridge into Goose Lake Valley. Thus we have a continuous string of valleys with low divides extending about 125 miles nearly north and south, traversed by a good road. On the heavily timbered divide between Chewaucan and Goose Lake there is a good saw-mill which furnishes the people of the valleys with lumber.

On Thanksgiving day, November 28, we reached Lakeview, the county seat of Lake County, Oregon, and a thriving town. Hence we marched to Camp Bidwell, going by the new road being built by Mr. Ayers across the Warner Mountains. This is an excellent road, and will be the chief route across the mountains when fully completed.

We reached Camp Bidwell on the last day of November, about five o'clock, and within half an hour the side party under Mr. Kahler, which had been detached at The Dalles just one month before, came in also. This coincidence in time of arrival after traveling each about 400 miles and working along the route was a little remarkable.

Being under orders not to disband until the 15th of December, I sent Mr. Kahler with a party to do some work in the unfinished atlas-sheet east of Bidwell, which, however, they were unable to do, on account of a severe snow-storm, and they wisely returned to the post. After the work of the disbanding camp was done, I sent Messrs. Kahler, Goad, and Pitcher in an ambulance, kindly furnished by the quartermaster of the post, to Reno, meandering the road thereto. This finished the field season of 1878, so far as work in the field was concerned.

The party of four men, consisting of Mr. C. P. Kahler. Mr. T. W. Goad, Frank Collins, and Jack Condit, which left The Dalles October 29, moved first to the southeast, meandering the road and putting in the topography of the country between The Dalles and Sherar's Bridge across the Deschutes. Thence the party crossed the river and worked up the country lying between the John Day and the Deschutes Rivers, in the southeastern part of atlas-sheet 20 A. This section is to a great extent covered with rich bunch-grass; in some parts, however, it is rocky and covered with small bowlders. The country is cut up with cañons debouching into the Deschutes or John Day and many branch ravines and cañons. Water in small quantities is found in many of these cañons, and also considerable timber—cottonwood and willow. After spending some time about this country, the party struck out for Camp Bidwell, traveling at first by the Cañon City road. About Currant Creek and Cherry Creek the country is described as being very rough and piled up into small hills with massive jagged rocks cropping out in every direction, assuming fantastical shapes. It was down among these hills and rocks that the settlers of the country round about, during the Indian excitement of the summer, brought their flocks of sheep and herds of cattle and horses.

Leaving the John Day River at the mouth of Bridge Creek, the party proceeded along the road up this creek, and over the mountain road, towards Old Camp Watson. Mr. Kahler says of this section: "All the section that we have traveled through to-day, and some distance to the eastward, presents a rich field for the geologist—every variety of rock, quartz, sandstone, granite, limestone, conglomerate, &c. Numbers of fossil remains of animals of different kinds, also the impression of palm leaves and other tropical plants, have been found in the strata on which the rim-rock rests. The country presents the same rugged, broken appearance as that we passed through yesterday. With the exception of where we are camped this evening, the country has been pretty well cleared of grass by the sheep and cattle. The country is fast filling up with settlers." Over the mountains to the southward, through a country alternately covered with grass and destitute of all vegetation, the party traveled and came to Beaver Creek, a tributary of the Crooked River. From Beaver Creek across to Buck Creek the route lay through Long Hollow, well watered and with great quantities of grass. From Buck Creek, across a timbered ridge, the party passed to Silver Creek, and camped at Old Camp Curry.

Mr. Kahler says: "Making an early start from Camp Curry, our course was to the southeast down Silver Creek for about 25 miles. All the country from Camp Curry shows strong evidences of the devastation committeed by the Indian raiders. With the exception of the ranch near which we are camped to-night, all are deserted. About all of the ranches are to be seen the carcasses of the horses and cattle killed by the Indians. From Camp Curry our route lay over a flat alkali country, covered with sage-brush and greasewood and in season with tolerable grass, to a point where Silver Creek passes through a rocky gorge, about 13 miles from Camp Curry. It was at this point that Captain Bernard had a fight with the Indians, and near are the stone breastworks thrown up by his men."

Thence the party marched until the Harney road was reached, and on this road across the desert to Mule Springs, and thence to Warner Valley, and by the main traveled road to Bidwell, which point it reached November 30. The party experienced many hardships, as it was very cold and stormy most of the time, rain and snow falling, and the roads being either very muddy or frozen and slippery.

The results of the field-work of this section of the survey have been to give three and partially four reconnaissance lines across Oregon from California and Nevada to the Columbia River. These lines were all carefully meandered, the country as far as possible in the vicinity examined and sketched, profiles run with cistern and aneroid barometers, and checks made at frequent intervals by sextant latitude observations.

Particular attention was paid to gaining such information as will be useful in a more thorough and elaborate survey of the area; peaks suitable for triangulation and topographical purposes were located as closely as possible; the general characteristics of the country were noted with reference to the supplies it can be made to furnish, and also with reference to the accessible and practicable routes of travel.

Besides these lines, a base line was measured and developed and connected with the astronomical monument at The Dalles, and the topography of the quarter atlas-sheet 20 A was nearly completed, all being done except the work in the immediate vicinity of Mount Hood, which could not be accomplished on account of the lateness of the season.

The following is a numerical list of the principal observations made during the season, number of miles traveled, &c:

Number of sextant latitude stations occupied	18
Number of bases measured	1
Number of azimuths measured	1
Number of triangles about bases measured	4
Number of main triangulation stations	11
Number of secondary triangulation stations	1
Number of meander stations occupied	2,195
Number of variations of needle taken	57
Number of miles meandered	2,673
Number of miles traversed and not meandered	608
Number of monuments built	18

r of camps made during season	128
r of cistern-barometer stations	169
r of aneroid stations	1,570
t altitude, approximately (feet)	9,500
altitude, approximately (feet)	310
r of thermal springs	3
r sets sextant time observations	22
r sets hourly barometric observations	1
r of pointings at main and secondary triangulation stations	803
r of rivers and creeks gauged	1
r of rock specimens collected	2
r of specimens of mineral waters collected	1
r of zoological specimens (about)	1,000

have the honor to be, very respectfully, your obedient servant,

THOMAS W. SYMONS,
Lieutenant of Engineers.

. GEORGE M. WHEELER,
Corps of Engineers, in charge.

APPENDIX C.

RT OF LIEUTENANT EUGENE GRIFFIN, CORPS OF ENGINEERS, IN CHARGE OF PARTY NO. 2, COLORADO SECTION, SEASON OF 1878.

UNITED STATES ENGINEER OFFICE,
GEOGRAPHICAL SURVEYS WEST OF THE 100TH MERIDIAN,
Washington, D. C., March 26, 1879.

I have the honor to submit the following report of the operations of party No. 2, do section, of the surveys west of the 100th meridian during the field season of

e 5th of July, in accordance with your orders, I left Washington for Fort Union, exico, the rendezvous camp of party No. 2, Colorado section. I was delayed at arland, Colo., assisting Lieutenant Birnie in fitting out his party (party No. 1, do section), and on other duty, reaching Fort Union on the 21st. On the 4th nst the party was completed and ready to take the field, organized as follows: tenant Griffin, executive officer and field astronomer; Mr. F. O. Maxson, topog- ; Mr. W. G. Walbridge, assistant topographer; Mr. Mark B. Kerr, meteorolo- Ir. W. A. Phillips, jr., odometer recorder; three packers, and one cook. The vas provided with the usual allowance of instruments, the necessary camping eight riding-mules, twelve pack-mules, and one horse.

nstructions were to proceed southward from Fort Union to Fort Stanton, com- ; on the way, the detailed meander work in atlas-sheets 78 A, 78 C, and 77 D; efitting at the latter post to carry on the detailed topographical survey of atlas- 84 D, and that part of 84 C lying eastward of the Rio Grande.

he 5th day of August the party left Fort Union, and topographical work was nced on the following morning, the party filling in those portions of sheets 78 A C where additional details were required. At Pozos del Pino, or Alkali Holes, 14th, the party was divided, Mr. Maxson, with Mr. Kerr and one packer, passing east of the Gallinas Mountains, and the remainder of the party to the west, nabling us to complete, at once, all work requisite for the final plot of atlas- 7 D. On the 17th Mr. Maxson reached Stanton with his party, and I arrived 18th.

area has been traversed, in previous years, by parties of the survey, and com- lescriptions of the country given in their reports. The narrow belts which we l up presented no marked features, and differed in no respects from their sur- ngs; they do not, therefore, require further remark. Sheets 84 D and 84 C, the of which constituted our main season's work, had never been entered previously ties of the survey. To give an intelligent idea of our movements necessitates description of the country in which we operated.

ts 84 D and 84 C are included between the parallels of 33° 10′ on the north and on the south, and longitudes 105° 30′ on the east and 108° 15′ on the west. The esignated for the party to occupy, however, was limited by the Rio Grande on st, which included only about two-ninths of sheet 84 C. This designated area oximately 5,618 square miles.

lering the Rio Grande lies the Caballo range of mountains, trending nearly north uth. Rising rugged and precipitous in the north, they decrease in elevation the south, finally dividing into a double range, and sinking gradually to the latitude 32° 40′, where the river bends to the east. But little water is found in nountains; indeed, nearly all this portion of the Territory, except a strip of varying width bordering the river, is dry, and, were one dependent on natural water supplies, would be well nigh impassable.

About thirty-three miles to the east are the San Andreas Mountains. These also lie meridianally, and are more elevated and broken, more barren and dry than the Caballo Range. They are a southern prolongation of the Oscuro Mountains. In latitude 32° 25′ they break down nearly to the plain, forming the San Augustin Pass. South of this they rise even higher than before, and are there called the Organ Mountains. The towering, conical, and slender pinnacles rising in profusion, but with regularity, resemble the pipes of an immense organ, and suggested the name, which is certainly appropriate. Again, they are broken by the Soledad Pass, and south of this they are known as the Soledad Mountains, and still further down as the El Paso or Franklin Mountains. Near the town of Franklin, Tex., they come to an abrupt termination. The Rio Grande, bending eastward, cuts through the range, forming here the boundary between the United States and Mexico.

The Jornada del Muerto (Journey of Death) lies between the Caballo and San Andreas Mountains. This is a dreary level waste, stretching from the Fra Cristobal Range on the north for some ninety miles to the south. It is covered with fine gramma grass, but the scarcity of water renders it valueless for grazing purposes. The Ojo del Muerto (Spring of the Dead), near the north, Toussaint's Ranch, Martin's Well, and a stage station at the Point of Rocks are the only places where water is to be found.

East of the San Andreas Mountains is another plain, a sandy desert, stretching for some 43 miles to the east and terminated there by the Sacramento, Guadalupe, and Hueco Mountains. This was over the bed of an ancient ocean, but the waters have long ago receded, leaving only salt lakes and marshes dotting the plain and surrounded by quicksands. In brief, the area to be surveyed consisted of three parallel ranges of mountains, separated by two extensive plains or deserts.

It was considered advisable to work up the San Andreas Range at once, during the rainy season, as later on it would be more difficult if not impossible, owing to the scarcity of water. The necessary repairs to the outfit being completed, on Monday, the 26th day of August, the party left Fort Stanton. For three days we were accompanied by Lieutenant Wright, Ninth Cavalry, and twenty Navajo Indian scouts, who being skillful hunters, kept us supplied with game. On the 27th we reached the Mal Pais, an immense lava bed, which had been surveyed the previous year by Lieutenant Morrison, Sixth Cavalry. Crossing this by one of the only two practicable or possible routes, we proceeded down the western edge, and on the 30th entered the area of atlas-sheet 84 D, making camp at a water-hole fortunately filled by recent rains. Mr. Maxson, with one packer and ten days' rations, left us at the camp, to work down the range, carrying the meander well over to the western border and into the Jornada. This difficult and laborious operation was completed with his usual skill and success.

From the Mal Pais Spring, at the southern point of the lava-bed, a wagon-road runs south, along the eastern edge of the mountains, to the San Augustin Pass. The main party meandered this road, and obtained all the details, both of the plain and the mountains in the vicinity. The road followed was, at times, hardly passable; pools of water were seen, but investigation showed them to be salt, and the surrounding quicksands made them difficult of approach; a running stream of the clearest water was also salt, and on following the road to the edge of an immense salt-marsh we found ourselves plunged in a dangerous quicksand. With difficulty the pack-mules were extricated, and, abandoning the road for a time, we continued our journey on the higher ground near the mountains. No water was found at the end of the first day's march, and our camp was made on the sand, with but little if any grazing for the animals. On the following night we camped at the San Nicholas Spring, about two-thirds of a mile up a cañon in the mountains.

The clearness of the atmosphere at the high altitude we were in (about 4,200 feet), made objects distinctly visible at almost incredible distances. From this camp, looking across the almost level desert at our feet, we could see the Sacramento Mountains on the farther side. Their outline could be clearly traced; the mouths of the immense cañons which abound on their western borders were distinctly visible; the giant masses of rock forming the sides of the cañons, rising in some places to a vertical height of 2,000 feet, seemed so near that the mind refused to credit their extreme distance of 50 miles.

We remained at this camp for five days, obtaining the topography in the vicinity, and being detained by heavy thunder-storms. Mr. Maxson arrived on the 6th, and on the 9th the main camp was transferred to San Augustin. The Organ Mountains on the south, and the San Andreas Range on the north, bending westward at this point, form an immense rincon, open to the east and rising gradually to the San Augustin Pass. On the northern slope of the Organs are several springs, and here two dwellings have been erected, forming the town of San Augustin.

In 1866 Mr. W. F. Shedd made the first settlement here, and Shedd's ranch is widely known in this country, more so, perhaps, than the more recent appellation of San Augustin. It is only within the last few years that traveling, even in parties of considerable size, has been safe in this vicinity, on account of the Indians. The erection of ry posts and the increased number of troops have confined the Indians more closely ir reservations, and the traveler is now comparatively safe. The grazing on the gentle slopes is excellent; though not luxurious, the grass seems to possess great ious properties, and supports a flock of some 10,000 sheep and several herds of

od wagon-road leading over the pass crosses the Jornada del Muerto to Las Cruces esilla—two towns on the Rio Grande. A branch from this, just across the pass, to the town of Doña Ana, a few miles north of Cruces. From the pass a road direct to Fort Selden, on the river. On the 11th the party crossed the pass, and, ing the Selden road, while Mr. Maxson meandered that by way of Doña Ana, d Fort Selden the same night.

t Selden had ceased to be a military post, but the Government property still was guarded by a small detachment, under command of Lieutenant Cory, Fif- Infantry.

r resting the transportation two days at this post, we journeyed northward gh the Jornada over a well-traveled stage-road, remained in camp one day at the of Rocks, while the topographers were working in the vicinity, and reached Ale- r Martin's Well on the 16th. Here, in the center of this vast sandy plain, is a f pure water, having a depth of 160 feet.

the 17th we camped at the abandoned post of Fort McRae. On the 19th we d the Caballo Mountains over the Palomas Pass, and made camp on the bank river. The pass is utterly impassable for wagons; in fact, it can hardly be a pass, as the trail leads directly over the crest of the mountains, hardly lower point than at others. It was a delightful change from the barren plains on we had been traveling to the rich, fruitful country in which we now found our- . Between the mountains and the river the soil is fertile and well cultivated, e many trees afforded us a grateful shelter from the scorching sun. Watermel- antaloupes, fruits, and vegetables of all kinds, and chili, the national dish of the ans, were plentiful and cheap. The ground is irrigated by acequias or ditches, , starting from the river several miles above the town which they are intended ply, follow a gentle slope, and distribute the water by side drains throughout ace. The acequias are municipal works, and the major-domo de las acequias, or intendent, an important municipal functionary, is elected by the people. In of emergency, he is empowered to turn out the entire population to save the ia, which is frequently the only water-supply of the village.

had reached the northern limit of our work, and after remaining four days in amp, to enable the topographers to complete their notes, we started down the on the morning of the 24th. Our object now was to meander the river, and at me time obtain the necessary data for an accurate plot of the mountains on our In following the course of the river, in many places we were obliged to travel on w trails literally cut into the face of the mountains, which, stretching out to the presented nearly vertical walls. These difficulties were finally overcome, and on th the party reached Fort Selden without accident.

the 29th we started southward on the stage-road, and passing through Doña Ana, d in Las Cruces. Doña Ana is a true Mexican town, formerly very prosperous e commercial center of the southern part of the Territory; now it has greatly ished in population and its commercial importance is entirely gone. Abandoned ined dwellings line the plaza and mutely tell of its departed glory. Las Cruces esilla are the successful rivals. The former is situated about nine miles farther the river, and is one of the most important towns in the Territory, having a pop- n of about fifteen hundred. Mesilla, a few miles farther south, on the western of the river, has a population of one thousand.

the 1st of October we reached Fort Bliss, in Texas, 46 miles south of Cruces. ountry through which we had traveled was a continuation of the Jornada del o, and marked by the same characteristics. The road turns from the river bot- fter leaving Cruces, and in following it we lost the river until just as we ap- hed Fort Bliss.

troops were quartered in the little town of Franklin, occupying buildings rented e government, no quarters having been erected or reservation designated for the We remained in camp here until the 15th. During this time we were treated the greatest courtesy by all the officers at the post, who gave us every assistance ir power, and contributed in every possible way to the speedy and successful letion of our work. We received like courtesy and consideration from all officers whom we came in contact.

t Bliss had been occupied as an astronomical station by Mr. Rock, of the survey, r in the season, and I had instructions to connect his monument with the main ulation to the north, and also to connect with the initial monument of the Mex- Boundary Commission which located the Mexican boundary in 1855. For this se I at once commenced the measurement of a base line. A nearly level plain, about s to the east of Franklin, was selected, and after the direction of the line had etermined and the ground prepared, two measurements were made with a stackpole, 50-foot, compensated, steel tape. The first measurement was made by Messrs Maxson and Walbridge, and the second by Mr. Maxson and myself, resulting as follows:

First measurement, 8049'.689+0'.632 (temp. correction)	8050.321
Second measurement, 8049'.789+0'.512 (temp. correction)	8050.301
Mean adopted	8050.311
Level correction	0.030
Reduction to sea-level	1.321
Length of base at sea-level	8048.960

The temperature of the tape was read every thousand feet, and the difference of level obtained for the same distances, the character of the ground rendering any further refinement in the latter respect unnecessary. Eight triangulation stations were occupied, including the two ends of the base and two monuments of the Mexican Boundary Commission. One mountain-peak was occupied in Mexico. In this work Mr. Maxson was invaluable, and I cannot testify too highly my appreciation of his zeal and energy and thorough familiarity with his work. I am also indebted to him for many timely suggestions, which his knowledge of the country and long experience on the survey rendered doubly valuable.

On the morning of the 14th Messrs. Walbridge and Phillips, with one packer, started northward for San Augustin, following a good wagon-road which runs to the east of the Soledad and Organ Mountains. The last two triangulation points of the development were successfully occupied during the day, and on the 15th the main party followed, abandoning the road, however, and making camp at a little spring in the mountains. On the following day we climbed and occupied the North Franklin Peak, the remaining point of our system of triangles. In the descent, by an unfortunate accident, the triangulation instrument was ruined, falling some 400 feet down the side of the mountain. On the 17th we reached Shedd's ranch, after a weary march of 41 miles, and found the remainder of the party in camp there. Here we remained for six days, the topography of the Organ Mountains being obtained by short trips from this camp. On the 23d I visited the Stevenson Mine in these mountains, the only mine within the area we occupied that has been worked. On the 24th we left Shedd's ranch for the last time *en route* to Fort Stanton, following a well-traveled road. On the 25th we camped at the White Sands, on the Mal Pais plain. This is a peculiar formation; an area of about 46 square miles is covered to a mean depth of about 30 feet with gypsum. At a distance it has every appearance of an immense snow-bank, and even on close approach it is difficult to divest oneself of this impression. The sand is rather coarse; shrubs and bushes grow in it to some extent. It is said that this bank shows a continual growth, and there is abundant proof of its yearly increase in a horizontal direction. The road runs close to it, and the constant encroachments of the sand have in time converted what was formerly a straight road into an immense arc. This is probably due, however, to the drifting of the sand by the winds rather than to an actual increase in the total bulk. A spring bubbles up from under the sand-bank, and the water, though not palatable to man, is greedily consumed by the thirsty animals after their long and hot journey through the sands; it is strongly alkaline and mineral. On the following day we passed the Lost River; a considerable stream rushing up from the ground like an immense spring, flows on about ten yards, and sinks as mysteriously as it rises. The source and mouth of this mysterious river are unknown; at no other point in its course is it visible. That night we camped at the town of Tulerosa, and three days later arrived at Fort Stanton.

After resting two days at the post, we started, on the 1st of November, to complete our work in the Sacramento Mountains. On the 2d we camped at Elk Spring, 42 miles from Stanton. Our camp was in a beautiful cañon, with excellent grazing for the mules, and wood and water in plenty. With a few exceptions, we were equally fortunate during the next three weeks. These mountains are in reality an immense plateau, on their eastern slope cut by gentle cañons, with long and numerous branches running from the divide out towards to the Staked Plain. On the western slope the cañons are deep and rugged, with high, precipitous walls. They are heavily timbered, principally with pine, though scrub-oaks and quaking-aspens are quite numerous. They are well watered by several streams and by many springs. These springs are much more numerous on the eastern than on the western slope. Game is plentiful. Bear, deer, and turkeys, especially the latter, are numerous, and, judging from the tracks and cast-off antlers, many elk still range these mountains, though it was not our fortune to see one of these animals. The greater part of the mountains lie within the Apache Indian reservation, and this fact has kept settlers and prospectors almost entirely out of the country.

Work was prosecuted vigorously until the 22d, suspended only on the 8th and 9th by snow-storms. In these nineteen days we meandered 356 miles, and traveled altogether 626 miles. On the 21st and 22d we were without water, having left our water-kegs behind at Fort Stanton, and failing to find any springs, we turned back toward the Peñasco Creek, which we had left about a week before, and at noon on the 23d we reached it, with the mules in a very weak condition and the members of the party heartily tired of subsisting on bear's meat alone. At 5 a. m. on the 24th a viosnow-storm began, which continued all day. The next morning found the ground red to a depth of 15 inches, and no signs of a cessation of the storm. At 7.30 . we broke camp and started for Fort Stanton, a distance of 79 miles. At 4 p. m. torm ceased, leaving a depth of over 2 feet, and we camped at a little spring. mules were in a very bad condition. Lack of food, combined with the intense and difficult traveling through the snow, had weakened them all, and it was tful whether they could hold out. On the 26th we traveled 21 miles, and camped lk Spring. On the 27th 22 miles brought us to Dowlin's Mill, a government forgency, and on the following day we easily made Fort Stanton. I found awaitne instructions to disband the party on or about the 10th of December. Accord-, the property was boxed and stored, and on the 7th the party disbanded, and the ral members started for their homes.

e following is a summary of the work done:

triangulation stations occupied	9
ndary triangulation stations occupied	8
e-point stations	251
ider stations	1,898
ber of variations of needle determined	30
rn-barometer stations occupied	98
oid-barometer stations occupied	1,235
tings made on triangulation stations	2,249
meandered	1,679.68
l miles traveled	2,672.57
re miles surveyed	4,656

ere are no valuable mines in the area we occupied that have been discovered and ked, but this subject has never received the full investigation that it deserves. ntiferous galena was found through the San Andreas and Organ Mountains, and are indications of both silver and gold bearing rock in the Sacramento Moun-. The galena ore is not valuable, however, only averaging from $10 to $18 to the

e Stevenson mine, in the Organs, has been worked, but to little profit. The dis- from the railroad and consequent great cost of transportation has induced the ers to stop work for the present. A lawsuit, now in progress, involving the title e mine probably had its influence in this respect also. Most of the silver thus aken out has been found in pockets in the limestone that constitutes the surface-. A shaft has been sunk, however, and a true lead reached in the solid granite. lead trends northeast and southwest. From different assays, and the practical ting thus far, the rock is found to average about $33 to the ton.

ool is, perhaps, the most important product of the country. The immense plains sheltered rincons in the mountains, together with the mild climate, make this try one well adapted to sheep-raising, and considerable wealth is invested in this ch of industry.

ttle-raising is the principal occupation of many. Agriculture is but a secondary uit, as there are so few places where the soil is suitable.

anklin, or El Paso, Tex., is the seat of the custom-house of the district of Paso Norte. On the opposite bank of the Rio Grande is the old Mexican town of El , having a population of about 5,000. The character of the commercial inter-se between the two countries, at least in this district, is shown by the following e, kindly furnished me by Mr. Slade, the collector of this district, to whom I am bted for many other acts of courtesy.

DISTRICT OF PASO DEL NORTE.

Exports and imports for the year ending December 31, 1878.

EXPORTS.		IMPORTS.	
l valuation	$60,000 00	Total valuation	$420,873 46
hiefly cotton and woolen goods.		Principal commodities:	
		Silver coin and bullion	$313,381 00
		Cattle	59,916 00
		Wheat	5,543 00
		Wheat-flour	7,244 00
		Corn	6,337 00
		Beans	4,287 00
		Sugar	3,307 00

e position of the initial monument of the boundary line between the United States Mexico, as determined by the commission of 1855–'56, is as follows: Latitude, 31°

47′ 00″; longitude 106° 31′ 23″.5. Our determination of the same point differed somewhat: Latitude, 31° 46′ 58″.54; longitude, 106° 31′ 34″.02. This shows a difference in latitude of 1″.46 or about 147 feet, and in longitude of 10″.52 or about 906 feet. Our determination of the position of the El Paso cathedral showed a remarkable coincidence with that of the boundary commission. As published in their report, the position is, latitude, 31° 44′ 15″.7; longitude, 106° 29′ 00″. As determined by our party, latitude, 31° 44′ 15″.11; longitude, 106° 28′ 59″.77; showing a difference of only 0″.59 in latitude and 0″.23 in longitude. The longitude of the astronomical monument was determined by telegraph, and carried to the other points by triangulation. The boundary commission determined their longitudes by "lunar culminations."

The 4,656 square miles surveyed by the party may be approximately classed as follows:

Arable, with irrigation	132
Grazing, good	2,984
bad	652
Timber, large	439
small	169
Arid or barren	280
	4,656

In conclusion, I desire to thank the members of the party for their untiring energy and cheerful co-operation under all circumstances. To Mr. Maxson is due, to a very great extent, the success of the season's work. Mr. Walbridge rendered valuable assistance in the topographical line, and Mr. Kerr as meteorologist and Mr. Phillips as odometer-recorder were all that could be desired.

I am, very respectfully, your obedient servant,

EUGENE GRIFFIN,
Second Lieutenant of Engineers.

Capt. GEO. M. WHEELER,
Corps of Engineers, in charge.

APPENDIX D.

REPORT OF LIEUTENANT WILLARD YOUNG, CORPS OF ENGINEERS, IN CHARGE OF PARTY NO. 2, UTAH SECTION, FIELD-SEASON OF 1878.

OGDEN, UTAH, *March* 17, 1879.

SIR: I have the honor to submit the following report of operations of parties under my charge during the season of 1878:

SURVEY OF GREAT SALT LAKE.

Instructions from you were received early in March, at the field-office in Ogden, to organize at once a party for the survey of Great Salt Lake. A plan for prosecuting this work had already been submitted, and in reply your directions were: That a careful meander of the shore-line of the lake and of its islands should be made; that the amount of inflowing water should be determined by measuring all streams flowing into the lake; that observations should be made to determine the surface-evaporation as well as the rise and fall of the lake; that all necessary topographical notes of the country immediately bordering the lake, and of the islands, should be taken.

Soundings were to be made when practicable, but as our operations were confined entirely to the land, and land-transportation only used, nothing in this respect could be done.

The party which took the field March 11, consisted of myself, as executive officer; Francis Klett, topographer; Louis Seckels, meteorological observer and chainman; Corporal John T. Hill, Fourteenth Infantry, chainman; Private M. G. Brenholtz, Fourteenth Infantry, packer; Private Joseph Messer, Fourteenth Infantry, cook and assistant packer; Sergeant F. L. Hoffman, Fourteenth Infantry, was left at Ogden in charge of the observatory, and was to make the prescribed meteorological observations there, and was charged with making the experiments for determining the evaporation and rise and fall of the lake. The instruments supplied were one six-inch Würdemann theodolite, reading to ten seconds; one Y-level; one Young & Sons' topographical transit, reading to one minute; one gradienter, and the necessary meteorological instruments. Five riding, four pack, and two team mules, with a light spring-wagon, were the means of transportation.

The principal streams entering the lake are the Jordan, Weber, and Bear Rivers, and these are the only ones whose discharge was to be determined by regular current-observations. It was only possible, from the small size of the party, to gauge these streams in succession; and as it was desirable that this should be done as nearly on the same date as possible, and as only the eastern and northern shores of the lake could be meandered without the aid of a boat, the mouth of the Jordan River was selected as the initial point most favorable for our work. After determining the dis-

'ge of the Jordan, our first care being to find a suitable place for our observations, regular meander work of the shore-line was commenced.

he surveying party proper, consisting of the topographer and two chainmen, fol- ed, as nearly as possible, the actual shore-line; and an average of seven or eight 's per day was found to be good work. A great deal of soft, sticky mud was ›untered, making the walking very difficult and the chain very hard to drag.

meander work along the eastern shore, around the Promontory, and along the ;hern shore of the lake, was prosecuted almost without interruption, until a point ıt eight miles south of Kelton was reached. A few days of stormy weather were ɜrienced, and a short delay made at Weber and Bear Rivers to gauge these streams. eing impracticable to continue the work further without the aid of a boat, and as could not be furnished, the party, after waiting several days in Kelton for in- ctions, returned to Ogden on May 12. Around the Promontory, and where the 'e could be closely followed with the wagon, measurements were made with an ueter instead of by chaining. Three-point stations, to serve as checks to the k, were frequently made. Careful topographical notes of the Promontory Moun- s were taken, and two of the principal points occupied as triangulation stations. ɘful estimates of width, depth, and velocity of all streams encountered were .e, so that the total inflow of water to the lake could be determined. The only ıms not observed by us in this way are those entering the lake at its southern end, lying west of Jordan River, and the few small springs on Antelope and Stans- y Islands.

ıere are a few springs known to exist below the present level of the lake surface, of course no estimate of the amount of water discharged by them could be made. total discharge from all other sources, not including Jordan, Weber, and Bear ɜrs, as given by our observations, is 222 cubic feet per second. When it is remem- ›d that these observations were made during the months of March and April, after streams had begun to rise, and when the springs were well supplied with water ı the last winter's snows and rains, and that at this season none of the water was rted for purposes of irrigation, it is not too much to assume that this result will esent a fair annual mean of the inflow from these sources.

CURRENT OBSERVATIONS.

gauging the Jordan, Weber, and Bear Rivers, sub-surface-floats only were used y were made from ordinary five-gallon coal-oil cans, the tops and bottoms of the being cut out. Wires were soldered diagonally on the inside to serve as an attach- t for the cord connecting with the surface-float. Light slips of pine board were ›d to the proper length and fitted on the inside near the top of the can, to give it cient buoyancy. Each can was connected by a fine cord to a small tin elliptical ., carrying a flag. This served to keep the main or sub-surface-float at a constant h, and the flag marked its course. Opposite each base-line four or more cross- ons of the stream were made, by taking soundings at distances of 10 feet.* The ıms being narrow, the distances were very accurately determined by stretching ı bank to bank a cord marked at distances of 50 and 10 feet, respectively, with :e and red rags. These graduated cords, when placed at the extremities of the -line, afforded a very easy and accurate method for determining the course of each

ıe results obtained are given in the following table. I base my estimate for mean ıarge on a study of the character of the channels and on information gathered as he relation existing between the height of the water at the time of measure- t and at the flood and low-water seasons, as well as the probable duration of high ›r.

Stream.	No. of floats.	Measured volume, in feet, per second.	Estimated mean volume, in feet, per second.	Remarks.
n River—Measured March 12, 13, 1878, at ıegar's Ranch, near the mouth of the river	55	875	1,000	Mid-depth flow only.
ır River—Measured March 22, 23, 1878, at ıa. below mouth of Ogden Creek	95	882	1,200	Mid-depth flow only.
River—Measured April 6, 7, 1878, at Co- ıe	125	2,507	3,500	Mid-depth flow only.
y from all other measured sources	....	222	222	Estimate of width, depth, and velocity.
y from Tooele and Skull Valleys and from ıd*	....	....	78	Estimated.
Total	....	....	6,000	

The mean inflow to the lake for the year 1878 would thus be 6,000 cubic feet per second. This result is not to be relied upon as giving a correct mean. Such would be the case, very nearly, if the sources of these streams were constant springs, and if they were allowed to flow in their own channels throughout the year without being diverted for purposes of irrigation; but, depending as they do largely upon the melting of the mountain snows, an almost daily fluctuation during the spring and summer months is noted, and the amount is, besides, perceptibly decreased during the season of irrigation. During the season of high water the volume is many times that of the fall and winter months, and it is very difficult to form a correct estimate of the mean inflow.

Observations were made by me in March, 1879, to determine the height of the lake surface as compared with its height of the same date in 1878. I find that, in the year thus included, the lake fell 2,575 feet, or about 31 inches. The average annual rainfall for Salt Lake City for the past ten years is over 20 inches, while the rainfall for the year ending March 20, 1879, as taken from the records of the signal station at Salt Lake City, is but 16.02 inches. A marked decrease in the lake's supply is thus shown, both of inflowing water and of rainfall.

An inflow of 6,000 feet would in a year suffice to cover the lake to a depth of 40 inches. Adding to this the total rainfall assumed for the whole lake to be 12 inches, and the fall of the lake surface 31 inches, we have for the total annual evaporation 83 inches.

EVAPORATION, ETC.

The observations for determining the evaporation and rise and fall of the lake were made by Sergeant Hoffman at Lake Side, near the village of Kaysville. This point was selected as being convenient to Ogden, and, besides, as being distant from any large streams of fresh water and from the mountains.

A wooden pillar, graduated to feet and inches for 5 feet of its length, the zero being at the bottom, was set in the lake, in about four feet of water. On March 18 the water-surface read 1 foot and 9 inches. A large wooden stake, to serve as a permanent reference-mark, was driven near the flag-staff, and its top connected by leveling with the zero of the water-scale. It was found to be 11.075 feet higher than said zero.

For obtaining the evaporation, a wooden box, lined with zinc and made perfectly water-tight, was provided. Its interior dimensions were 24 inches by 30 inches, by 14 inches deep. It was so weighted by counterpoises passing over two grooved standards, in which it was made to work, that, when filled to within 2 inches of the top, it was not more than 3 inches above the lake surface. It was placed in the lake near the graduated pole. The water in the box would thus be subjected, as nearly as might be, to the same influences of temperature, sun, wind, rain, &c., as the water in the lake.

The amount of evaporation was to be taken directly from the box by scale and vernier reading, or was to be determined by measuring the fluid-ounces contained in the box when filled and the amount remaining at the time of observation. The difference, referred to the size of the box, would give, it was thought, a more correct measure than could be obtained by vernier reading. Other necessary meteorological observations were also to be made in connection therewith. The whole apparatus was placed in position on the 18th of March, a clear, calm day, and seemed to work well. Later, however, and after repeated trials, it was found that no reliance could be placed in the results obtained. If the lake was at all rough, the dashing of the waves against the box would soon fill it with the spray thus formed; and on several occasions the box was found totally submerged and sunken, a result, as I suppose, of the undulatory action of the waves, which would not allow a free action of the box in its grooved standards.

On being informed of this failure, other methods were proposed to Sergeant Hoffman which might prove more successful; but he did not find opportunity to carry out my suggestions, his time, until his death, being fully employed at Ogden with Professor André and associates, who were busily engaged in preparations for the transit of Mercury.

The circumstances of the sergeant's sad demise have already been reported in full to you. Sergeant Thomas Knight, Fourteenth Infantry, was afterwards detailed to take the late sergeant's place, but no further observations were made at Lake Side.

SUMMARY OF WORK DONE.

Variations of the needle	6
Three-point stations	128
Triangulation and topographical stations	9
Creeks and ditches measured by estimating width, depth, and velocity	40
Rivers gauged by current-observations	3
Miles measured	255.8

Divided as follows:

y time and three-point stations	49.5
y odometer	60.5
y chaining	145.8
nps	22
ys from Jordan River to Kelton	54
ys delayed by storm	9
tern-barometer observations in the field	118
eroid-barometer observations in the field	118
tern-barometer observations on triangulation stations	16
eroid-barometer observation on triangulation, topographical, and meandered tations	155

DEVELOPMENT OF THE TERRACE-LUCIN BASE.

n the fall of 1877 a base-line, a little over 24 miles in length, was measured along line of the Central Pacific Railroad between Terrace and Lucin. Two measurents were made, under the direction of Messrs. Klett and Kintner, civilian assistants. e work to be done by the party under my charge was to level this base, and to so elop it as to connect with the system of triangles to the northward and eastward upleted in 1877.

he personnel of the party was the same as that engaged in the survey of Salt Lake. e instruments, field-equipment, and transportation, were also the same, except that wagon was taken. Triangulation instrument No. 112, by Würdemann, was very ch out of order. Application was made to have it replaced by a better one, but s was not done. The results obtained are not, it is feared, as good as could be ped for in consequence, although great care was taken, by multiplying observations, eliminate all source of error.

The party left Ogden on the evening of May 23, by rail, and reached Terrace the xt morning. On inquiry, it was found that the monument erected by Messrs. Klett d Kintner the previous year at Lucin had blown down, and had been removed and stroyed. Two members of the party were, therefore, at once sent forward to rebuild and cover it with white cloth, a supply of which had been provided on leaving Ogn. The monument at Terrace was still standing. The work of leveling was at once dertaken and carried forward to completion by Messrs. Klett and Seckels. On ocpying the extremities of the base, the monuments were found to be indistinct, even the most favorable times of the day for observing. It was, therefore, decided to rease their size, and a height was given to them of from 25 to 30 feet, while before y stood but 12 or 15 feet above the ground. On every station but one, where the w was not obstructed by mountains, sights were taken to both monuments. At lot Knob the Lucin monument could not be seen, for the day we made the ascent this mountain proved to be hazy, and the Terrace monument was undistinguishle.

The work of leveling being completed and stations made at the extremities of the se, we proceeded to occupy, in order, the following points: Desert Peak, Pilot Knob, wfoundland Peak, Clear Creek Peak, Citadel Peak, Deer Peak, and Tangent Peak. is completed the work assigned us, and, returning from the field, we reached Ogden ne 20. Topographical notes were taken by Mr. Klett at nearly all the mountain tions, and the heights of all were barometrically determined.

The history, resources, and general geology of the Salt Lake Valley and Desert are o well known from previous reports to require from me any further description.

Mining locations had been made and some work done near South Promontory ak; at Newfoundland, where there is a district organized; at Silver Islet, or Desert ak; and in the Clear Creek hills, north of Terrace. At none of these places was rk being prosecuted at the time of our visit. Locations were noted on the east side the Ombey Mountains, in the vicinity of Pilot Knob. On the western slope of ese mountains, distant from the railroad about eight miles, and in the State of Neda, is situated the once thriving mining town of Buell. Work in some of the mines the vicinity is still carried on, but only to a limited extent. Specimens of ore were tained only at Newfoundland. These are principally carbonates and sulphides of pper, with some argentiferous galena of low grade. The district has been almost andoned since 1871.

Following is a brief summary of the work done on this trip:

iangulation stations	9
pographical stations	3
mps	14
ys in the field	28
ys in traveling	12
ys on stations	8
ys in leveling base	6
ys delayed by storm	2

The prescribed meteorological observations were made every night and morning at camp, and barometric readings werè taken on each mountain station.

PARTY II.—UTAH SECTION.

This party, which was organized at Ogden, Utah, in the latter part of July, consisted of myself, as executive officer and field astronomer; Frank Carpenter, topographer; William Hollis, meteorological observer; W. A. Purrington, aneroid and odometer recorder; George Stewart, chief packer; Corporal J. T. Hill, Fourteenth Infantry, packer; and Charles Harris, cook. One man to act as guide, herder, and man of all work was engaged on reaching the field.

The work intrusted to us was the completing of the survey of the country lying within atlas-sheets 73 A, 73 C, 73 D, and 80 A, left unfinished in 1875. Instructions were also given us to continue the work southward from Los Angeles toward San Diego, as far as time and the weather would permit.

We took train at Ogden, with our complete outfit, on the 26th day of July. The point selected for commencing actual field work was Caliente, Cal., and this we reached on August 2. All the supplies for the season were received here. From this point we proceeded to meander the Kern River to its forks, near Kernville, and to survey two small unfinished areas; one lying west and south from Owen's Peak, and comprising the country in the immediate vicinity of Walker's Pass; the other lying north of Kern River, on the slope of the mountains towards Tulare Valley, and comprising the country drained by Posa Creek.

The route of the party from Caliente was down the cañon to the railroad station Pampa, across the foot-hills, and down Cottonwood Creek to Kern River, and thence over the Breckenridge Mountain to the mining town of Havilah. From this point the stage and freight road running from Caliente to Panamont was followed, up the south fork of Kern River and through Walker's Pass, to Coyote Hole, a stage station on the edge of the Mojave Desert. Returning, a new line over the hills and down the Kelso Creek to the town of Weldon was meandered. A trail running down the Kern River Cañon took us to the old mining camp, now abandoned, of Dahlonega. The mines here are said to have been the first worked in Kern County. We were enabled to proceed but little farther along the river beyond this point, as the cañon below here and to its mouth becomes a narrow, rock-bound, and impassable gorge. We therefore turned northward across the mountains and descended to Posa Creek. A few days in this region sufficed for Mr. Carpenter to gather the necessary topographical data, when we proceeded to meander Kern River from the mouth of the canon to Bakersfield. We then returned to Caliente for supplies.

The foot-hills bordering the Tulare Valley, west of Breckenridge Mountain, and those north of Kern River, were well covered with the grasses of the country, and, where not eaten out by sheep, the feed was abundant. In the other portions of the country traversed by us the grazing was but indifferent. An abundance of fine pine timber was found near the summit of the Breckenridge Mountain, and in the vicinity of Posa Creek and near Caliente the hills were covered with oak, live-oak, and sugar-pine. In the country east of Havilah and Kernville but little timber of any kind was found. Along the south fork of Kern River, and in the valley where the north and south forks come together, there are about 20 square miles of cultivable land, with a sufficiency of water in the river for irrigation. A considerable sum of money would have to be expended to carry water to all this land, which, judging from appearances, is not very productive.

Posa Creek sinks before reaching the plain, and only furnishes water for a few ranches along its banks while yet in the mountains and foot-hills.

Kern River, as it debouches into the valley, furnishes water enough to irrigate about 200 square miles of land. It is being mostly utilized on the plains about Bakersfield, where there are large companies formed which own and control the water-rights.

Leaving Caliente August 25, a line around the north side of Livermore Mountain to the old Tejon Reservation was meandered. From this point our course was through Tejon Pass to the Desert, and thence across the Liebre Ranch to Elizabeth Lake. Here we entered the cañon of Castac Creek, which we followed to its mouth, on the Santa Clara River. Then, crossing by trail the mountains to the south of this stream, we reached the old mission of San Fernando, September 1. This country was visited by parties of the survey in 1875. The only new ground touched by us was the Castac Cañon. The country through which this creek runs, from Elizabeth Lake to within a few miles of its mouth, is almost utterly worthless, being covered with a thick growth of chaparral and other brush, to the exclusion of all other vegetation. Near the Santa Clara the brush runs out, and the hills are covered more or less luxuriantly with herbage of different kinds, affording very good pasturage. A great many sheep are herded here. Bear, deer, and quail abound in the cañon. Near its head, and for some distance below Elizabeth Lake, the rock of the cañon is of a true granitic structure. About midway down the cañon, however, it changes to a kind of dolorite, schistose in struct-

, and very much tilted and twisted. Still lower it changes to a pudding-stone, and n to a sandstone.

'he next unfinished area to be surveyed by us was situated west of our camp at San :nando Mission, and comprised portions of the San Fernando, Conejo, and Santa nica Mountains, and of the Simi, Las Posas, Santa Clara, San Fernando, and Los geles Valleys. Our time until October 3 was fully occupied in this region in mean- ing roads and trails, and in occuping topographical and other stations. The sea- st in the vicinity of Santa Monica for several miles, and from San Buenaventura beyond Hueneme, was also meandered. The only lava seen during the season was nd in the hills at the lower end of the Simi Valley. For description and resources this region reference is made to the reports of former years.

n the 4th day of October the party left Los Angeles for the San Gabriel Cañon, sing on the way the beautiful San Gabriel Valley and the old mission of that name, d to have been the first established by the Spanish padres in this region. The old irch here is in tolerable repair, and religious services are still held there. The sur- nding country, which is largely taken up in orange culture, is the most beautiful ited by us during the season. The work in the cañon progressed very slowly, from almost impassable nature of the trails we had to follow, and especially owing to absence of grass or forage of any kind for our mules. The four principal forks re meandered as far as it was possible to penetrate with our animals. The extreme stern fork, which rises immediately under San Gabriel Peak, was named Joy Cañon honor of Mr. Douglas A. Joy, geological assistant of division No. 2 in 1875, who in t year traversed the whole distance from San Gabriel Peak to the mouth of the ion on foot.

'here are extensive deposits of detritus and *débris* all along the cañon, which are iferous, and gold-washing has been and is still carried on to a considerable extent. ere was some excitement at the time of our visit about reported rich strikes at and r the Winston silver mine, near the mouth of the cañon, where a true fissure-vein aid to exist, and where there are silver deposits resembling in many respects those r Virginia City, Nev. With the exception of the mining interests and a little pine l oak timber near the summits of the mountains, very hard to get at, the entire ntry drained by the San Gabriel is worthless, and comprises one of the most dreary l uninviting regions imaginable. From the head of Joy Cañon we made a compar- vely easy ascent of San Gabriel Peak, and, although detained there two days by rmy weather (Mr. Carpenter and myself remaining on the peak during that time), at last succeeded in obtaining all wished-for results. We were just three weeks in cañon, meandering the stream and occupying the necessary mountain points, and ring that time our animals had become very much jaded and worn, so that for a ie but short marches could be made. After meandering San Antonio Creek to near head, and making a topographical station on a mountain west of the cañon and r San Antonio Peak, we took the road leading through Cucamonga to San Ber- rdino, and reached this latter point November 1. Mining in San Antonio Cañon had t received an impetus from new discoveries made there, and a number of parties re at work washing or prospecting.

t San Bernardino we supplied ourselves with rations for thirty days, from the neral stores that had been forwarded by rail from Caliente to Los Angeles, and ence to Colton. The surrounding country is a fertile, well-watered, and delightful lley of fields, vineyards. and orchards, and contains a mixture of American, Spanish, d Indian population. The principal business interests are centered in San Ber- rdino, though the town of Colton, but three miles distant, and situated on the rail- d, bids fair, as the general depot of this region, to rival it in time. We were de- ned two days at the mouth of Lytle Creek Cañon by a severe storm, the only one perienced during the season. The surrounding mountains were covered with snow lf-way down from their summits, and in some places to a depth of 18 inches, but it rapidly disappeared as to occasion us no other inconvenience than the delay men- ned.

The ascent of San Antonio Peak was made from the head of Lytle Creek on the 10th, d the next day we crossed over the mountains northward into Swarthout's Cañon, nping at Matthews' Ranch, where Lieutenant Whipple and party made a halt in '5. The rock around San Antonio Peak, and, indeed, throughout this whole sierra, granitic. The cañon of Lytle Creek towards its head is the most regular I have ever n, and exhibits signs of extensive glacial action. The east fork of San Gabriel ek, heading under San Antonio Peak, and just over the divide from Lytle Creek, o shows this same action to a marked degree. Gold placer-mining has been carried to some extent in Lytle Creek, but the work is now abandoned south of Swar- ut's Cañon. On the mountains dividing it from San Gabriel and Rock Creeks, an undance of fine pine timber is found, interspersed with a little redwood. Water in arthout's Cañon is quite scarce, only appearing as springs at different intervals ng the cañon. Locations have been made at each of these, and several ranches e been started, where potato-growing is a great success.

After following down Swarthout's Cañon to near its mouth, on the desert, and turning to the east and crossing a low ridge, we entered the main Cajon Wash at its head, the aneroid reading 4,510 feet on the divide at this point. The projected railroad from Los Angeles to Independence was to have run through this pass, and the grading in this vicinity is completed for a distance of several miles. In crossing from the wash to the desert a long tunnel is necessary, and work on this had also been commenced. The wagon road does not follow the main pass for more than half of its length, but turns to the right up a narrow, rocky cañon, and thence passes from its head on to the desert. We followed this road from the mouth of the cañon to a mile beyond Fear's stage station, and then crossed over on to the west fork of the Mojave River. An extensive plain or valley, well covered with grass, along this stream to the forks of the river, affords pasturage for great numbers of cattle and horses. At the time of our visit the range was overstocked, and the grass pretty well eaten down. At the forks of the Mojave we found an encampment of about fifty Pah-Ute Indians, including men, women, and children, very comfortably fixed (though living in wickiups) and tolerably well dressed. They have water ditches constructed to irrigate about 10 acres of land, and this they farm each year. Their principal food, however, consists of pine-nuts and such game as they can kill in the surrounding mountains. Nearly all the water of the river at this point comes from the east fork, and it all sinks a short distance below the Indian camp. I estimate that there is water enough coming out of the cañon here to irrigate a thousand acres, and there is more than this amount of land in the plain below. Of its fertility I cannot speak, though I judge it to be not very productive.

Up to this point the hills were more or less thickly covered with chaparral and other brush, if timber of some kind was not found; but here we encountered the true desert country. The hills to the eastward, which we skirted by following the true desert plain, were entirely destitute of vegetation, except a scattering growth of bunch-grass, and resembled, in their dry, parched appearance, the isolated groups of mountains which rise here and there from the Great Mojave Desert and add to its dreariness and desolation. Farther east, as we ascended the road leading to Holcomb and Bear Valleys, brush and piñon pine were again met with; and, finally, extensive forests of beautiful pine were encountered, stretching eastward as far as Santa Ana Creek and the San Bernardino Mountain, and westward along the summit of the mountains to the Cajon Pass. Several steam saw-mills have already been built, one at Holcomb Valley, the others in the mountains just north from San Bernardino, which supply the surrounding country with lumber. The mining and timber interests of this region are the only ones of any considerable value, though the grassy swamps of Bear Valley afford good pasturage during the summer months. At the lower end of this valley the water collects into a large, shallow lake, which is a resort for thousands of geese and ducks. The principal rock formations are still granitic, though there are some quite extensive limestone deposits, notably in the vicinity of the Green lead mine, west of Holcomb Valley, and in the Lone Valley mining district. There is also some limestone found in the foothills east of Cajon Pass, and on the south slope of the mountains. East of Bear Valley the hills are mostly covered with piñon pine and the higher mountains with pine timber.

From our camp at Lone Valley two topographical stations were made; one on Mineral Hill, so named from extensive mineral deposits; the other on a point near the divide between the headwaters of Whitewater and Santa Ana Creeks From Bear Valley we crossed over the mountain into the cañon of the Santa Ana, and meandered that creek from the fork near its head to near the mouth of Bear Creek, beyond which it was impossible to penetrate; then, crossing the west end of the San Bernardino Mountain, we descended into Mill Creek, at Forsee's Ranch, and from there proceeded to San Bernardino, which we reached November 29.

In Mill Creek there are two or three ranches, where fruit-growing is a principal business. The mills, from which the creek took its name, were destroyed by a flood in 1862, and have not been rebuilt. Forsee's Ranch, here situated, is a favorite camping spot for pleasure parties seeking relief from the intense summer heat of the valley below. In Santa Ana Cañon there are several large *cienegas*, where during the summer a great many cattle are pastured. A large fish-pond was built here at considerable expense, and fish-culture entered into; but it has proved a failure, mainly, I judge, from the want of a market. Besides pine and oak, some very fine cedars are found in this cañon.

Orders were found awaiting us at San Bernardino to disband the party in time to reach Sacramento with our outfit not later than December 12. Four days were spent in the mountains to the north of San Bernardino, to complete the topography of that region; and then, following down the Santa Ana River, we reached Santa Ana December 7. On the 9th our animals, stores, and public property of every description were loaded on to cars and started for Sacramento. Arriving there, everything was transferred to Lieut. B. H. Randolph, Third Artillery, quartermaster of the survey;

ad the work of disbanding, storing, and shipping, carried to completion under the irection of Lieut. S. E. Tillman, Corps of Engineers.

The following list shows the principal observations made by the party:

extant latitude stations	9
lain triangulation stations	2
hree-point stations	106
leander stations	1,571
lonuments built	43
ariations of the needle taken	8
liles measured	1,176.44
liles traveled and not measured	462.25
amps	96
istern-barometer stations	176
neroid-barometer stations	1,044
ays on the march	118
ays in camp	11

Information concerning the mining districts examined will be found under the head f mining notes elsewhere.

Very respectfully, your obedient servant,

W. YOUNG,
Second Lieutenant, Corps of Engineers.

Capt. GEO. M. WHEELER,
Corps of Engineers, in charge.

APPENDIX D (SUB).

EPORT OF LIEUTENANT WILLARD YOUNG, CORPS OF ENGINEERS, IN CHARGE OF A SPECIAL PARTY ENGAGED IN THE SURVEY OF GREAT SALT LAKE AND VICINITY, FIELD SEASON OF 1879.

UNITED STATES ENGINEER OFFICE,
GEOGRAPHICAL SURVEYS WEST OF THE 100TH MERIDIAN,
Ogden, Utah, July 18, 1879.

SIR: I have the honor to submit the following report of the operations of a special arty engaged in the survey of Great Salt Lake and vicinity during the field season f 1879.

The party was organized at Ogden, Utah, and consisted of myself, as executive officer nd triangulator; Francis Klett, topographer: Louis Seckels, meteorological recorder nd chainman; Sergeant Thomas Knight, Fourteenth Infantry, chainman; Private oseph Messer, Fourteenth Infantry, cook; Benjamin Brown and Lewis Brown, boatnen; making in all a party of seven men.

The boat chartered to furnish transportation for the party was the Joseph Brown, f Salt Lake, a sloop-rigged yacht of about nine tons burden. We had besides a catigged skiff, which was used in landing and in general coasting where the water was hallow. The surveying party used the latter boat most of the time, as good headway ould be made with the oars, even when the wind proved unfavorable for sailing. It rew about one foot of water, while the large boat drew about three feet.

Instruments, rations, and the general camp-equipage having been shipped from gden, the party proceeded by rail from that point to Lake Side on the Utah Cenral Railroad, meeting there on April 22, 1879, the Messrs. Brown with their boats. The eneral stores were at once loaded on to the boat, and everything placed in readiness o commence the survey work as soon as the weather would permit, it being at that ime stormy, wet, and cold.

In plotting the work of last year, a portion of it, from the Jordan River to Lake ide, proved unsatisfactory, and it was therefore decided to run a new line between hese points, so as to correct any errors there might be in the old work, and to exercise he men in their duties before reaching new ground.

The weather proving favorable, work was commenced April 22, and from that time n was vigorously prosecuted. Stations were made along the shore at distances of one or wo miles apart, with a ten-inch Würdeman transit, and the position of each marked y a strong wooden stake, firmly driven into the ground and appropriately marked nd numbered. A meander line was run between these points with a Gunter chain nd a Young & Son transit by the topographer and his assistants, which afforded e means of gathering all necessary data regarding the conformation of the shore.

The work of running this meander was very fatiguing and trying to those engaged in it; the walking, almost without exception, being difficult, either from water, mud, or loose sand. For this cause and for the reason that the work of chaining would, of necessity, be frequently interrupted along the western shore, and especially around the rocky shores of the islands, this method of conducting the meander was not continued beyond the northern end of the Stansbury range of mountains, near Skull Valley; but from that point forward three-point stations with the large instrument were made more frequently, and the shore line between them sketched in and fixed by cross-sights. This change enabled us to make much greater progress, and it is thought the results will prove even more satisfactory.

On May 26 we reached the point where work was discontinued in 1878. Each of the principal islands in the lake was then visited in turn, its shore meandered, and the highest point carefully occupied as a triangulation station. Stations were then made with the large instrument at three different points on the promontory, and at two points on the eastern main shore, to serve as checks to last year's work. The shore line of the lake eastward a few miles from the mouth of Bear River, which was left unfinished in 1878, was filled in, and the river itself meandered from its mouth up as far as Corinne. This latter point was reached June 20, and here we dismissed the boat and boatmen. Thence proceeding by rail, we arrived in Ogden June 21.

Preparations were at once made to visit Mount Grant and occupy it as a main triangulation station in connection with our work. This was done on June 28, and on our return Mr. Klett and myself reached Ogden again June 30. The other members of our party, Sergeant Knight and Corporal Brenholtz, Fourteenth Infantry, delayed at Lake Side to assist in construction of an evaporation tank for determining the lake evaporation, and did not reach Ogden until July 2.

A meander of the Weber River, from the Utah Central Railroad bridge at Ogden to the lake shore, was also made.

Observations at the Ogden office are now being made during three days of each week, to determine the evaporation from the lake surface. The results thus far show a daily average of about $\frac{2}{8}$ of an inch for the month of July.

While on the lake some care was exercised in gathering specimens of lake water, salts, fossils, &c., to add as far as possible to the general knowledge of the country visited by us.

Lines of soundings were made whenever possible without interfering with our other duties. Time, however, did not permit any systematic work in this regard. The water brought from the lake—in all, twelve bottles—taken from the bottom, mid-depth, and surface, respectively, at four different points in the lake, and the specimens of mud and salt, have been submitted to Professor Kingsbury, of the Deseret University, Salt Lake City, for analysis.

Following is a summary in brief of the results obtained by the season's labor:

Points occupied as main triangulation stations: Mount Grant, Antelope Island, Monument Point, Skull Peak, Stansbury Island, Lip Peak; total, 6.

Points occupied as secondary triangulation stations: Dolphin Island, Carrington Island, Gunnison Island, Hat Island, Miller's or Fremont's Island, Strong's Knob; total, 6.

Number of three-point stations with large instrument (Würdeman, No. 160)	193
Number of three-point stations with small instrument (Young, No. 5063)	218
Number of pointings made on primary and secondary triangulation stations	2,590
Average for each station	216
Number of points occupied as meander stations	435
Number of three-point stations at land-office stakes or marks	2
Stone monuments built	50
Variations of needle by Polaris	7
Needle-readings from triangulation points	4
Number of miles chained	92.27
Number of miles traveled and not chained	300
Camps made	42
Points occupied as cistern-barometer stations	12
Points occupied as aneroid-barometer stations	2
Highest altitude noted (Mount Grant), feet	10,500
Lowest altitude noted (lake surface), feet	4,200
Mining camps	1
Days in travel	55
Days in camp	15
Streams gauged	16
Rock specimens collected	10
Ore specimens collected	6
Fossils collected	12
Botanical specimens collected	22

oological specimens collected, some in water	
arvæ of insects, cans	2
ud from lake bottom, bottles	2
umber of soundings recorded	500
eepest sounding made, feet	39

Very respectfully, your obedient servant,

WILLARD YOUNG,
Second Lieutenant, Corps of Engineers.

Capt. GEORGE M. WHEELER,
Corps of Engineers, in charge.

APPENDIX E.

EPORT OF LIEUTENANT ROGERS BIRNIE, JR., ORDNANCE CORPS, IN CHARGE OF PARTY NO. 1, COLORADO SECTION, FIELD SEASON OF 1878.

UNITED STATES ENGINEER OFFICE,
GEOGRAPHICAL SURVEYS WEST OF THE ONE HUNDREDTH MERIDIAN,
Washington, D. C., *March* 15, 1879.

SIR: I have the honor herewith to submit a report of operations of Party No. 1, Col· ado Section, for the field season of 1878.

The party to which I was assigned was organized at Fort Garland, Colo., and t that place for the field on the 26th of July. The following persons made up e party: Lieut. R. Birnie, jr., executive officer and field astronomer; Mr. Louis ll, topographical assistant; Mr. John A. Hasson, meteorological observer; Mr. G. Schleicher, meteorological observer; Mr. E. W. Lyon, odometer recorder, with lix Burgess and E. W. Davis, packers; Thomas Wells and John Johnson, cooks; d J. B. Grant, laborer. Mr. E. Gillette, jr., afterward joined us at Santa Fé, N. ex., August 3, 1878, and throughout the season performed the duties of assistant pographer.

The instruments assigned to the party or received during the field season and used us, were, Sextant No. 1475 Stackpole & Bros., and artificial horizon, No. 11; eodolite No. 123, Buff & Berger (with adjustable standards), reading to 10″; theod-ite, No. 1649, Stackpole & Bros., reading to 20″; transits, Nos. 4951 and 4952, Young & ns, reading to 1′; compensated steel tapes, Nos. 1 and 7; one odometer vehicle, single heeled; odometers Nos. 10, 15, and 16; field compass, No. 8, and Abbott compass, No. ; cistern barometers, Nos. 1988, 2159, and 2161; aneroid barometers, Nos. 2088 and 97, with attached thermometers; pocket thermometers, Nos. 17 and 24; psychrome-rs (sets), Nos. 5, 16, and 20; maximum and minimum thermometers, Nos. 6 and 14.

The party was designed to work in Southwestern New Mexico, which necessitated a arch of over 400 hundred miles from Fort Garland to reach its field of work proper, t en route some old work was to be checked and the country between the Rio Grande out Albuquerque and the Puerco was to be traversed with reference to its topogra-y and the routes of travel from Albuquerque west toward Fort Wingate.

Enough rations were taken at Fort Garland to last the party as far as Sante Fé, to hich place we first proceeded. The meander was begun at the ferry near the mouth of e Trinchera, and thence Mr. Nell went through the lower settlements on the Conejos d returned to the Rio Grande at Myers' ferry. An old stockade, said to have been ade by Pike near the Conejos, was sought for, but its site could not be certainly fixed. rom Myers' ferry a meander was run, following as closely as possible along the west nk of the river, to the ferry and ford at Cieneguilla. Cattle trails were found the ost part of the way, but no travel follows that route. The river flows through a deep d rugged cañon—the bank at San Cristobal crossing, 600 feet high, may be taken as n average. Cattle crossings are found opposite Los Cerros, near San Cristobal, and t the mouth of the Arroyo Hondo. From Cieneguilla to Santa Fé our route was over he main road, which had been surveyed and measured by your parties in previous ears.

At San Ildefonso, Mr. Nell with a small party left us to survey the cañon of the iver between that place and Peña Blanca. At Santa Fé I made arrangement for ations for the party during the season, and our barometers were there compared with hose of the Signal Office..

We left August 6, and marched to Peña Blanca where Mr. Nell arrived two days ater. He had strictly confined his route to the cañon of the river from San Ildefonso own, and had been compelled to travel a good part of the way along the rocky slopes, ithout trail and oftentimes crossing and recrossing the river. He made an accurate route survey of this exceedingly rough cañon. Peña Blanca was a suitable place from which to enter the country that we desired to survey, between the Rio Grande about Albuquerque and the Puerco. The party accordingly marched southwest from Peña Blanca toward the little plaza of San Francisco on the Puerco. The meandered route crossed the river at Peña Blanca, where there is a good ford—followed down the west bank a few miles to Cubero and thence was over a little-used trail to the pueblo of Santa Clara on the Jemez.

Crow Spring, apparently only a water-hole but having permanent water, was visited; it is in the lava bluffs of one of the short cañons that cut up the cliffs on the west side of the river in this vicinity, and about one and three-fourth miles west of Cubero. It can scarcely be made of use except for cattle, though there was local talk of the advantage of a road crossing the Rio Grande at Cubero and passing this water, in preference to the established road through Peña Blanca toward San Ysidro Springs, this latter being very sandy. Near this water-hole was shown me the bed of what could only be a very old and long-since disused road; the rough lava rocks had been well cleared to either side, but now were fallen back, while there appeared a well-worn route, making a straight course nearly due east and west, and visible for a mile or more from our point of observation. I would incline to attribute its origin to the Indians, as it connects apparently the Indian towns on the Rio Grande with those on the Jemez, but in that case the amount of intercourse between the two places, as probably also the Indian population and power, has largely decreased. Indeed, the pueblo of Santa Clara presented to the traveler a most marked example of stagnation and, inferentially, of decay. It is built on the bank of the Jemez, where the stream-bed is a sand-flat nearly a mile wide, and the little rivulet of muddy water in it seemed scarcely to know what course to take; on the town side, the sloping bank on which it is built extends back a few hundred yards to the lava cliffs; on the opposite side, a few scattered cedar trees struggle for sustenance in a ridge of sand-hills; vegetation seems to have deserted the place; there were no gardens, because there is no water to irrigate in the dry season. One herd of about 40 cattle was brought to the corral in the evening, and there were numerous sheep and goats, so that all the wealth of the town semed to be their herds. We got a little corn for our animals, which must have been obtained by trade, or perhaps their cultivated fields were distant from the village. They could speak a little poor Spanish, but no English. There was a church and a priest's house, kept ready for the padre at his visit. Their food consisted principally of milk and corn, cooked and made up in various dishes. The isolation of this town, apparently due more to the desire of its inhabitants than its position (for it is less than a score of miles from the towns on the Rio Grande), made it for me an object of striking interest.

Continuing southwest from this pueblo, we passed through the sand-hills along the Jemez and crossed an elevated table-land, sloping toward the Rio Grande, with good grazing. About five miles from the Puerco, the well-defined ridge that runs parallel with it and forms the divide toward the Rio Grande was crossed. On the Puerco slope, and about three miles from the river, we passed Alum Spring. The Puerco Valley was reached just after it had been visited by a severe rain-storm. The alkali mud near the stream was in places nearly knee-deep; the water, totally unfit for use, was flowing in a narrow, deep stream between high clay banks. The character of this stream makes it dangerous to cross except at well-known fords.

From the Puerco we returned to the Rio Grande at Albuquerque, taking three different routes. Mr. Nell passed over a portion of the road that leads from San Bernardino to Salazar, and connects with the Santa Fé road to Fort Wingate through Pena Blanca; the most direct road from San Francisco to Albuquerque was taken by Mr. Gillette; the third meander was through San Ignacio to Albuquerque. There is a ford of the Puerco, at San Ignacio, and thence a route leads west toward Cebolleta and Wingate. The crossing at Albuquerque may be made by ford or ferry. The ford is very dangerous, and the character of the banks and stream-bed makes an exceedingly poor place for a ferry. In traveling from Albuquerque south, the river may be crossed at this point and the road down the west bank taken, or the road through the meadows along the east bank may be taken to the ford at Isleta, which is an excellent one. This latter road is somewhat sandy in places, and in this respect perhaps somewhat inferior to the other.

From the ferry at Albuquerque, in addition to the road toward Wingate via San Ignacio and the road down the river, is the direct road to Wingate, which crosses the Puerco about eight miles below San Ignacio, at San Luis Rey; Mr. Nell took this road to the Puerco, followed down that stream to intersect the road from Los Lunas toward Wingate, and thence proceeded to Los Lunas, where I had gone from Albuquerque with a portion of the party, by way of the ford at Isleta. We had thus crossed the strip between the Rio Grande and the Puerco by six different routes, and obtained thorough and reliable data concerning its topographical and economic features. There are a number of old roads, but the two principally used between Santa Fé and Wingate are

ıat via Peña Blanca and San Ysidro, and second, that by the ford at Albuquerque
ın Luis Rey bridge on the Puerco. Neither of these roads was followed by us
ough to determine its merits.
travel to Camp Apache, Arizona, from the railroad termini at Alamosa, Cal.,
rinidad, if not through Fort Wingate, leaves the river at Los Lunas, and near
John's, on the Little Colorado, intersects the Camp Apache road from Fort Win-
Later in the season we traversed the part of this road that lies between Rita
ıda and Saint John's, but did not go over any of the portion between Los Lunas
:ita Quemada, which is said to be very destitute of water in the dry season.
Los Lunas we followed the main road along the west bank of the river to Ali-
My object was to traverse the North Star road—a new military road that leads
Fort Bayard north and passes directly through a portion of the country we
to survey. Properly this road meets the Rio Grande near the mouth of the
), but that portion between the Socorro Forks, near Pueblo Spring and the
), had been surveyed by Lieutenant Morrison's party in 1877. I therefore went
ımillo, and took the cross-road to the Socorro Forks by way of San Lorenzo
:. From Pueblo Spring to Monica Spring we traveled over a road meandered by
ıompson in 1873. Monica Spring is in atlas sheet 84 A, the eastern portion of
had been partly surveyed by Thompson's meander, checked by triangulation in
.nd completed by close work by Morrison in 1877, but the only work done in the
n west of the ridge of the Mimbres Mountains had been a meander by Sommers in
Thompson's and Sommers' surveys had been plotted, and having with us copies
se, we were enabled to see what had been done. From Monica Spring to Fest's
which was made the next objective point, a very circuitous route was taken,
ıwever that served well the purpose for which it was undertaken, viz, to develop
ıuntainous, and consequently the difficult portion of the country we had to survey.
rather in the nature of a reconnaissance, and indeed could not be much else, as
time (August 20) the rainy season commenced, and we had rain nearly every
ıring the succeeding two weeks and until we reached Fest's. Detailed topogra-
as afterward obtained where necessary, as we revisited the country at a better
, when working up the adjacent territory.
North Star road was our general course from Monica Spring to Magruder's, or
Mimbres, near Georgetown. It follows the old road to Luera Spring as far as
ıint of Rocks, and then takes a southerly course into the western slope of the
ıres Mountains, crossing the eastern branches of the headwaters of the Gila and
on the Mimbres near McKnight's ranch, follows down this stream a few miles
gruder's; thence there is a well-traveled road to Georgetown, Bayard, and Silver

n Monica Spring Mr. Nell meandered the trail through the western hills of the
ateo Range to Ojo Caliente and thence the trail to Shaw's ranch, on the North
ıad. The rest of the party followed the road to the forks of the Patterson road
San Augustin Plain from Ojo Caliente, thence along this road to the plain,
l the edge of this plain a few miles toward the south, and thence proceeded to
ı ranch across the open grassy country, where head the extreme (though dry)
of the Gila River; by this some twelve miles of the road was not traversed (at
ne).
.l desired to cross the Mimbres Range to Fest's Ferry with a portion of the party
the latitude of the ferry, but the ground was so soft that it was impossible to
off the road, and no traveled route across the range exists between Shaw's (over
.il to Ojo Caliente) and the one we finally took, which leaves the Mimbres some
miles below Magruder's and crosses the range near Mule Spring. This trail is the
ıt traveled route between Magruder's and the new mining town of Hillsboro.
Hillsboro we went by trail to Palomas, and thence along the river road to
Ferry.
point had been selected as the best adapted for carrying out your instructions
ırd to "finding a practicable route across the main divide of the continent be-
the Rio Grande and the head of the Little Colorado, so situated as to be the most
possible between El Paso and the head of the Little Colorado." It was believed
the ridge of the Mimbres, parallel to the Rio Grande on the west, there was no
able pass between Ojo Caliente and where the range merges into the plains to
ıth near old Fort Cummings. This supposition was found to be correct, except
route somewhat similar to, but not so good as, that by way of Ojo Caliente was
by Mr. Nell to be practicable by the head of the Cuchillo Negro. At Fest's a
of rations and an Indian pony, to replace one that had died, were received from
raig, so that two bell mares were available, and the pack-train could be divided.
party was divided. I took with me Messrs. Gillette and Lyon, and E. W. Davies
hnson as packer and cook, to make the party to go to the Little Colorado. The
the party were left with Mr. Nell to continue the regular topographical work.
ll was instructed to work southward between the Rio Grande and the summit
Mimbres in 84 C., and afterward west from the river toward Fort Bayard, in

the southern part of the same sheet. We were to meet at Fort Bayard on m
about the middle of October. From Fest's, by way of Ojo Caliente, was to be
ward route; on the return the drainage of the San Francisco (a branch of t
was to be made available to find a route from the Little Colorado to the vic
Silver City or Bayard, whence the plains lying south of the Mimbres Mounta
sent no obstacle to a route to the Rio Grande at Mesilla.

Both divisions of the party left Fest's on September 7.

TRIP TO THE LITTLE COLORADO AND RETURN TO SILVER CITY.

The accompanying map shows the route taken by the Little Colorado
going toward that river and the distances, the profile giving the elevatio
other routes of this party meandered are those across the Datil Mountains, an
Tulerosa; and the return route to Silver City by San Francisco River are not es
mapped, no well-defined route being developed by them.

At Fest's is a ferry and a good ford at low water; several roads converge to
the Jornada del Muerto or the plains on the east side of the river. They a
Fest's through the gap in the Caballo Mountains. The point is a very good
to approaches from that side, and a better road-bed can be had from El
Fest's by the Jornada del Muerto than by the river, owing to the heavy sand
near the river, and as the plain presents a more even surface. The map sh
outward route. It leaves the river at Fest's and passes over gradually-rising
until a high grassy plain is reached, some six miles from the river; cros
plain in a northwest direction until the abrupt bank of the cañon Alamosa is
Down this a road could be constructed at any desired grade. Once in this ca
drain conducts one to the low divide to the plain of San Augustin. Betw
town of Cañada Alamosa and the government post at Ojo Caliente the caño
many places very narrow and somewhat winding; a stream some six feet wi
three or four inches deep flows through it. Apparently there would be da
wash in the cañon at high water, but the wagon-road now passing through it h
used for a number of years. There is little wash, and the trunks of the trees and
do not evidence high water, and scarcely corroborate the story of the water
flowed with a depth of several feet throughout the narrow parts of the cañon
a few years past. Still it is certain that great care would be necessary to p
road built through this cañon from washing. On going up, the cañon prop
near the hot springs, which are situated in the little valley just above the
This opening (or entrance in going down) is remarkable, being like a narrow g
in the rocks, scarcely more than 30 feet wide and with perpendicular walls
dred feet high or more. The water from the springs which form the stream
shallow rippling flow that completely covers the floor of the gateway. In th
cañon below and 24 miles on the route from Fest's is the town of Cañada Ala
Mexican town of perhaps 100 inhabitants, who simply cultivate the flat, here
mile wide, using all the water of the stream for irrigating purposes. The gr
productive; several hundred acres are under cultivation. A few miles above t
the cañon narrows as stated. A stunted growth of wood appears on the ba
from Ojo Caliente good timber can be reached within a few miles. A saw
formerly in operation here, but is now removed. Throughout the cañon the st
shallow and in no place cuts out the bed.

In September, Ojo Caliente was the agency for about 300 Indians, held
quasi prisoners of war, deprived of their arms, under charge of Lieutenant Cu
of the Fifteenth Infantry, with a guard of some fifteen soldiers. The buildi
good, consisting of two sets of officers' quarters, a small barrack, a trader's st
house, and a good corral. The place cannot but impress one for its beauty and
The warm springs, several in number, with a temperature of 85°, are on the s
the low hills a little north of the opening of the cañon and about a half mile
buildings, which are on the south side of the main drain. The warm springs
the most of the water of the stream, but there are copious cold springs near th
ings. From the west several broad, open, but dry drains, filled with fine gra
verge at the post. It is up the longest of these, from the northwest, that
leads toward the Little Colorado. After Ojo Caliente, the next water on the mai
Luera Spring, after the southern arm of the San Augustin Plain has been cross
going from Ojo Caliente, we first pass the fork of the road (Patterson's) that fo
shortest road to the Tulerosa Pass. A limited supply of water will be fou
spring on this during the greater part of the year a couple of miles from th
In this vicinity there is good timber. Shortly after the divide to the plain is
are seen the forks of the road to Point of Rocks; next, the North Star road is cr
right angles. The direct and best route would pass through the low hills,
Luera Spring several miles to the south, but it is necessary to visit this
water. Plenty of timber is found about this spring. At present, the sprin
filled up, the water supply is very limited. The next water is the Encinosa

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evel plain to cross to within a mile and a half of the spring. A road forks to lerosa Pass, a couple of miles from Luera, and on the west side of the plain the road from Pueblo Spring (or Socorro) to the Tulerosa Pass is crossed.

inosa is an abundant spring: small oak trees grow about, and fine pine timber had from the slopes of the Horse Mountain, a few miles to the west. Leaving sa, the road traverses hilly country for several miles, but again enters the long, d gently-sloping drain that is crossed where the road left the San Augustin plainly giving an excellent grade if we pass around to the north of the hills Encinosa, but in this case the road would not pass the spring by a mile or more. ad now follows one fork of this drain up a gentle declivity to the Continental , which is crossed a few miles to the southwest of a well-marked, square-topped ain, called El Creston. On the west side, the road descends somewhat abruptly ut a half mile; then the slope is gentle to Rito Mangas, where is an abundant , and the road enters the drain of the Burnt Fork of the Little Colorado. For l miles on the west slope and adjacent to the road all the way from Encinosa to ide is an abundance of fine timber, much of that about the divide being of a le size for telegraph-poles.

he east side, several miles from the divide, is passed a growth of willows, where can apparently be had by digging, but the amount would probably be small. Rito Mangas to Carrizo Spring, or about 17 miles from Saint John's, the road s or is adjacent to the bed of the Burnt Fork, and its gentle slope leaves no ques- out the grade. At Rita Quemada is another large spring, forming a stream that r several miles as at Rito Mangas. At both these places Mexican settlements een established within a few years. There are three or four houses at Rito s, and perhaps twelve at Rita Quemada; probably 50 acres are under cultiva- the former place, and four times as much at the latter. At Rito Mangas are to nd the first settlers after leaving Ojo Caliente (a cabin has been put up at Enci- ut was, at the time we passed, unoccupied). As before stated, we intersect at uemada the road from Los Lunas to the Little Colorado. No large timber is near the road to Saint John's after leaving the vicinity of Rito Mangas, but the equently passes through growths of stunted cedar. After Rita Quemada, the oint of interest is Salt Lake. Shortly before reaching it a road forks to the at leads to Milligan's on the Little Colorado, by way of Coyote Spring. The road just along the north side of the Salt Lake, and from it one can look down into ession covering several square miles, the lowest parts of which are covered by ters of the lake, a hundred feet or more below the general surface. The depres- as evidently been formed by volcanic action; a couple of small black cones s) rise from the water. In one of these is said to be a small lake with water of greater saltness than the outer lake. The proportion of salt in this water is not , but is very great, and the bottom of the lake is covered with a thick layer of obtain which it is only necessary to throw out the sediment on the beach and ith clean water. It is the source of salt supply for a large area of country— others the Zuñi Indians, who are said to hold the vicinity in great awe. A of pure water issues from the bank of the depression near the west side of the e did not visit the spring. After leaving the lake, in a few miles, the road a number of fresh-water lakes—shallow, but quite extensive, and with *appa-* enough water to last through the year, but it is believed they would be quite May and June. The first permanent fresh water convenient to the road, after uemada, is found at Tule Spring, in the immediate vicinity of which there is d. Shortly after this the road leaves the drain and crosses the hills to La Pilla, ence to Saint John's. The drain of the Burnt Fork continues in a northwest di- , intersects the Zuñi River several miles from its mouth, and with the Zuñi s the Colorado some 15 miles below Saint John's; thus indicating a natural grade Little Colorado. Adjacent to the present wagon-road from Carrizo to Saint , the hills are rough enough to make the grading of a railroad difficult, particu- n the slopes toward the river; for here we cross a ridge of broken hills, rapidly several hundred feet to the plain adjacent to the river. A wagon-route to could probably not be better located than the present road, but a railroad hav- view extension down the Little Colorado would undoubtedly find a better route w the drain. We passed over the portion of the road in the Burnt Fork just he rainy season, and found its bed in many places very soft and miry, but this on would, I think, not exist out of the months of August and September.

oing over this route I think any one could not help being impressed with its ess, its grade, and the character of its bed, with little exception. The Conti- divide can be crossed by either a rail or wagon road without difficulty. The s generally well watered, and much of it well timbered, while from Ojo Caliente Little Colorado there would be no bridging and little cutting to make, even for oad. A direct line from El Paso to the mouth of the Zuñi will be found to pass re than 35 miles from Fest's Ferry, the point at which we left the Rio Grande to cross the mountains. It will be seen that this direct line cuts through the most inaccessible part of the Mimbres Mountains, making it necessary to pass either to the north or south of this group. This route by Fest's is to the north. As stated, Mr. Nell found that a good grade for a road could be established from the Rio Grande, by way of the Cuchillo Negro, through the mountains to Shaw's Ranch on the North Star road. Other observations in the country north and west showed that this route might be continued to connect with that by way of Ojo Caliente at some point in the San Augustin plain. With a view, however, to a route to the Little Colorado from the Southern Rio Grande by this way, it would be necessary to follow up the Rio Grande as far as Palomas; thence the land between that stream and the Cuchillo Negro could be crossed to the drain of the latter. To leave the Rio Grande below Palomas and to attempt to reach the Cuchillo Negro would necessitate the crossing of one or more of those terrible cuts that the streams flowing into the Rio Grande in this vicinity make in the gravelly table between the river and the Mimbres Mountains. Between the head of the Cuchillo Negro and Shaw's there is a great deal of marshy land, and the route through the cañon would be less direct than the Cañada Alamosa. Then from Shaw's to the San Augustin plain the route would necessarily be either difficult or circuitous. I conclude that the Cañada Alamosa offers a route quite as short as the other and much easier, there being already a good wagon-road, while there is not even a trail by the Cuchillo Negro.

Near La Pilla is crossed the boundary line between New Mexico and Arizona. Saint John's is a town of about 200 inhabitants, most of them Mexicans. The roads from Wingate and from the Rio Grande (Los Lunas) to Apache join at the town. The Little Colorado, here a stream some 12 feet wide and 8 inches deep, is crossed by a ford. The road to Apache afterward passes by Cave Spring, &c.

A road leads up the stream toward Springerville, about 30 miles distant. We took this route to examine the valley of the stream. Six miles from Saint John's is found two remarkable springs, called "Salt Springs." Both present a circular surface of water; the largest is about 20 feet across. About the springs the surface is a sedimentary rock, probably lime, formed by deposits from the water, which is not cold. Near the water's edge the rock has formed most rapidly, and presents a wall which is now more than a foot above the surrounding surface. The water flows in small quantity over the edge of the wall, which on the interior is nearly perpendicular. The deeper of the two springs is 40 feet. All around the springs is an alkali marsh, but the sedimentary rock has made a solid footing extending in one direction about 100 feet from the springs. The two are about 40 yards apart. A ranch has been built close to the springs, and is inhabited. The water is not unfit for use, and is drunk by cattle. A few miles above these again, on the same side of the stream (the west), is found a similar series of springs, called Tule Springs. The country about is rough, and cliffs 50 to 100 feet in height rise near the stream, sloping to the higher country on either side. The stream occasionally flows through cultivable valleys, containing from a few acres to several hundred. Evidences of cliff-dwellers are numerous. An old burial cave was found near Tule Spring, but was burned out by some careless or superstitious visitors. Old pottery may be found on the hills, and remains of stone dwellings.

A Mexican living at Tule Spring is now using to irrigate his land a ditch of stone. The water used is derived from the Tule Spring, and the ditch has been so long in use that it is, so to speak, fossilized. The present owner knows nothing of who made it, and, with reason, attributes it to the old inhabitants. Lying on the surface of the ground near by are the remains of another ditch, the segments of trough-shaped stones being in position for 100 yards or more. A few settlers are found along the stream. The road is difficult, encountering a number of hills, and within 12 miles of Springerville leaves the stream and traverses a high lava mesa. The stream cuts through this in a narrow, deep cañon, having in one place an extended and rapid fall. To construct a good wagon-road would require much labor.

Springerville is a thriving and growing settlement, situated in a beautiful valley of the stream. There are probably 150 inhabitants, a number of whom are Mexicans, but the improvements are due to Americans. Mr. Milligan was one of the first American settlers, and owns a ranch and mill. A road through the Datil Mountains, from the San Augustin plain, bears his name. From Springerville the road continues to Camp Apache.

The Milligan road is not used for through-travel from the Rio Grande. The road which branches from the Saint John's road at Salt Lake joins the Milligan road at Coyote Spring and passes through Springerville, but the greater portion of the travel is by way of Saint John's to Apache.

The Tulerosa Pass had been supposed the best through which to cross the Continental divide; in going out, however, we had left it quite to the south. To reach the Little Colorado at Springerville from the San Augustin plain had been my original intention, but the route by the Mangas Pass had been found so direct and good that it was first traversed. Even to come upon the Little Colorado at the mouth of the Zuñi,

les below Springerville, gives a most direct route to continue down the Little
ado.

proceeded, however, to examine the Milligan road and the Tulerosa Pass, partly
a view to a route from San Augustin plain, and partly to find a route from Spring-
e to the Tulerosa Creek, which, being a tributary of the San Francisco, would, if
ld be reached, offer a passage from Springerville, by way of the San Francisco,
ver City, which I had before planned as a return route.

rip was made from Springerville, over the Milligan road, to the San Augustin
Returning to Springerville a circuitous route was taken. We crossed the pass
lerosa, looked for a route up Apache Creek, and, failing in this, kept west along
ead of the drains of the San Francisco, and tried (from Paria's Spring) the pass
e Datil Mountains at the head of one of the drains of the main stream, which,
ng by the new settlement of Las Lentes, cuts through the San Francisco Mount-
n a deep gorge.

erward, from Springerville, a final route was examined to the drains converging at
entes, by passing from Springerville up Nutrioso Creek and by the west side of
scudilla Mountains, where the most northwesterly branch of the San Francisco
eaded and followed down to Las Lentes.

h routes from Springerville to Las Lentes were found difficult; that by the east of
scudilla, and which would fork from the Milligan road between Cienega Ama-
and Oak Springs to cross a low pass of the Datil, is generally the best, although a
iles longer. The other route already has a tolerable wagon-road from Springer-
to Bush Valley, which is near the head of the northwest branch of the San Fran-
; but from Bush Valley to Las Lentes the country is well nigh impracticable for
l of any kind, without a great amount of labor. At present a very rough road
s along on the north side of the stream. No natural road could be had close to
ream, which for a good part of its course passes through narrow rocky cañons.
ny well-graded route by Las Lentes to the Lower San Francisco must pass through
rge of the stream in the San Francisco Mountains.

ersonal examination of this gorge showed it to be impassable. For a couple of
it narrows to a mere crevice, with perpendicular walls of rock, being several
ed feet in height and the water of the stream completely filling the winding
e from one rocky side to the other.

return to the Milligan road and the Tulerosa Pass: The grade of the road, al-
h it might be improved in places, cannot be made good, and some bad, rocky
s cannot be avoided. The Tulerosa Pass is essentially a southwest one, and while
rs an easy route from the San Augustin plains to the Tulerosa Creek, and hence gives
s to the basin of the San Francisco, it in no way offers a pass to the Little Col-
. The rough country about where the Tulerosa Creek heads in the southwest
of the Datil Mountains and the Continental divide, the Datil Mountains them-
, and the cut-up, dry, mesa country to the north of them, combine to make a
graded route from the vicinity of Old Fort Tulerosa to the Little Colorado a diffi-
hing to accomplish.

before stated the final attempt to find a route from Springerville and follow down
an Francisco was made by Nutrioso Creek (which enters the Little Colorado at
gerville), thence down the San Francisco to Las Lentes. From Las Lentes to the
ments of San Francisco, where the Tulerosa joins, great difficulty was experienced
veling with only loose pack-mules. It was impossible to go through the gorge
stream, and to cross the San-Francisco Mountains, which, on their south side, fall
uccession of upturned strata bluffs where only a dim game-trail could be found
ces, and the pack-train was nearly three days in traveling a direct distance of
fifteen miles.

e idea of the rough character of this country can be had from what has been
but without a good map it is difficult to conceive how effectually nature has
ght to prevent man from traveling whither he may list. The headwaters of the San
isco, including the Tulerosa, heading in the Escudilla and Datil Mountains and
ard flowing through the San Francisco Range, which is south of and generally
llel to the others, are encased in narrow, rocky cañons, often boxed, and the coun-
out there can scarcely be described by saying that it is very rough. But this
country is not without redeeming features, as much of the basin between the
lilla, Datil, and San Francisco Ranges is made of open grassy country and pleas-
alleys. Las Lentes, a small Mexican settlement, is in this basin. Fine timber is
ng over the Escudilla, Datil, and on the north slope of the San Francisco. Oc-
ally fertile valleys are found along the streams. The Nutrioso is fast settling up,
Bush Valley, before mentioned, a thriving settlement has been started within
years by Mr. Bush and his sons, and other settlers are now coming in. On
e Creek is a recently established Mexican settlement called Apachita. At Old
Tulerosa is a settlement of Americans and Mexicans. Along the road between this
he San Francisco plazas are other settlers, and these latter plazas, three in num-
lready quite extensive, are rapidly growing Mexican towns, and now contain

several hundred inhabitants. A fine cattle-ranch has been taken up by Mr. Patterson, at Cienega, at the western edge of the San Augustin Plain. A few miles north of this is Horse Spring (also taken up) on the road from the Rio Grande to Old Fort Tulerosa. All of these settlements, including Springerville, trade with the towns on the Rio Grande. Although Silver City is much nearer, their roads lead to the Rio Grande but none to Silver City. The utility of one is apparent, but even from the plazas it will be a difficult matter to get a good wagon-road to Silver City.

In proceeding from the plazas to Silver City we still follow down the San Francisco, which, after the Tulerosa joins, is a rapid stream some fifteen feet wide and a foot deep. A dim, little-used, and washed-out road was followed down the cañon some twenty miles until, owing to the narrowing of the cañon, the road is compelled to take the hills on the west side, and, after a rough route of some six miles, returns to the stream at the head of what is called the "Meadows," where, for five or six miles, the stream flows through open meadows, in places a mile or more in width. At the foot of the meadows, in which we found the first settler was just establishing himself, the road again leaves the river and is somewhat rough and hilly for a few miles to Whitewater Creek, where is another embryo settlement. A couple of miles below Whitewater the road finally leaves the stream and crosses the drains from the Mogollon Mountains toward Duck Creek Pass. Entering this a fine slope extends to the Gila River. The road from Duck Creek to Mule Spring is intersected near the pass. We found that little work had been done on the road above Whitewater. With the exceptional cases where it traverses open ground it can scarcely be called a road until four or five miles below Whitewater, from which point, towards Duck Creek, enough work has been done to get tolerably over the bad places. The present route, with a good deal of labor, could be made a passably good wagon-road from where it comes to the stream at the upper end of the meadows, or probably twenty-five miles below San Francisco to the Gila, whence there is a good wagon-road to Silver City by Mangas Springs. The twenty miles of road through the cañon of the San Francisco below the plazas can never be kept in repair owing to the sandy character of the soil and consequent liability to wash. To build a road there would require a large outlay for bridges and grading as well.

Mr. Morley, engineer in charge of survey party for the Atchison, Topeka and Santa Fé Railroad, went over this route from the Tulerosa Pass a short time before we traversed it.

The principal difficulty, then, in building a wagon-road from the San Francisco plazas to Silver City is met in the first 25 miles from the plazas.

There is a fair road from the plazas up Tulerosa Creek, which passes the settlement at Old Fort Tulerosa, and thence, by way of Tulerosa Pass, leads to San Augustin plain, and gives an outlet to the Rio Grande.

The people at the plazas believe a road can be built from the towns, keeping in the foot-hills to the north and west of the stream, and coming upon it at the upper end of the meadows before referred to. In this event, and probably without a great outlay of labor, a mountain-road can be constructed from the plazas until the good part of the route is reached below Whitewater Creek, whence there is a good road to Silver City.

Springerville, Ariz., on the Little Colorado, should be connected with Silver City, New Mexico, by road. The road from Springerville to Bush Valley, being direct, would be utilized as far as the pass of the Escudilla Range, and probably as far as Bush Valley. From this place we tried to find a route by following the drain of the San Francisco and found it impracticable. A more direct route would be through the hills directly south from Bush Valley. It would probably have to pass to the southwest of the San Francisco mesas and reach the San Francisco at the meadows.

Had opportunity permitted I should have gone over this route also; but the drain of the San Francisco was selected as probably the most feasible. It is probable that, whether assisted by the government or not, the people of the country will construct a road somewhere in the vicinity of this indicated route within a few years.

From Duck Creek, instead of following the wagon-road to Silver City by Mangas Springs (known to be good), we took the trail passing by the north of Bear Peak. We crossed the Gila about five miles above Old Fort West, where there is a thriving farming settlement called "Upper Gila." The river above breaks out from a rocky gateway, in sight, in the Diablo Mountain, and here flowing through the open country is a rapid stream about 25 feet wide and 12 or 15 inches deep. From the Gila, until the old saw-mill at the head of Bear Creek and near to Bear Peak was reached, we had a rough trail; thence to Silver City a well-traveled wood road.

On the 30th of October we reached Fort Bayard, and joined the remainder of the party at Apache Tejo two days later. The result of our observations up to this time showed (1) that a good wagon-road already exists from Fest's Ferry by way of Cañada Alamosa, Ojo Caliente, Luera, and Encinosa Springs, and the Burnt Fork, to Saint John's, on the Little Colorado; (2) that a railroad could readily be constructed over or contiguous to this route; (3) that if the course of the Rio Grande were adhered to it passing north from El Paso it might be possible to somewhat shorten the total distance between El Paso and Saint John's (over the way by Fest's) by constructing the desired road by way of the head of the Cuchillo Negro, and thence joining the first in the San Augustin plain; (4) that the vicinity of the Tulerosa Pass offers no good passage to the Little Colorado for either a wagon or rail road; (5) that to connect Springerville with Silver City by direct route will be difficult, and at best it will be a mountain wagon-road; and (6) that between these two routes the country is so broken—there being the Mimbres, the Mogollon, the Diablo, the Tulerosa, and the Escudilla-Datil Mountains—that it is considered impracticable to construct a route in the direction desired, namely, in the northwest and southeast direction, for this direction cuts across these ranges.

The usual observations were made on this trip, a continuous meander line run, topographical notes taken, the measurements being made by odometer. Cistern-barometer observations were made as far as Encinosa Spring; after that, the cistern being out of order, the altitudes depend upon aneroid readings. Adjacent to that portion of our route within the limits of atlas-sheet 84 A, *i. e.* about the San Augustin plain, a number of topographical stations were occupied. From San Francisco Plaza, Eagle Peak was occupied as a main triangulation station on the 23d of October. The principal points sighted were Madalena, San Mateo Cook's and Thomas Peak (of the White Mountains). The three first made complete triangles in connection with Maxson's work of 1877, and Nell's occupancy of Cook's Peak, current year.

MR. NELL'S PARTY.

During our absence on this trip, Mr. Nell, with his party, had been steadily working in the country proposed. He had surveyed the country between the ridge of the Mimbres and the Rio Grande, from the Cuchillo Negro south to the road from Mesilla to Old Fort Cummings, as well as the vicinity of Cook's Peak, Hot Springs, and Apache Tejo to Fort Bayard. About twenty-five judiciously selected topographical stations tions had been occupied; the courses of the Cuchillo Negro, Arroyo Seco, Animas, Perches, and other streams from the eastern slope of the Mimbres meandered; the Rio Grande gauged at Palomas and Fort Selden, its course meandered as far south as Mesilla; the important roads of the country meandered; the mines at Hillsborough and in Cook's range located; a base-line about 5 miles in length, located at Apache Tejo to connect with the astronomical monument established at Fort Bayard, 10 miles distant, and several of the development stations occupied and monuments built on all. As located by Mr. Nell, the base lay nearly in a north and south direction, the middle point being about one-half mile west of the camp at Apache Tejo. It was so laid out as to be as nearly as possible exactly on the line joining two development stations (D and F), so that with the assistance of but two lateral points, the line between D and F, about 26 miles in length, could be determined. This line afforded at once a base for connection with Cook's, Florida, and Bear Peak, points embraced in the main triangulation. The base-line passes over the slightly undulating, grassy plain characteristic of the low lands, extending south toward the Mexican line. Leveling showed the southern station (B) to be 298.5 feet lower than (A). When laid out the line was marked by colored flags, 200 feet apart; two measurements were made with compensated steel tape, at an interval of two weeks, and entirely independent of each other, the extremities of the tape-line being placed on movable boards; the first gave 27,265.968 feet, and the second 27,265.920 feet. The ends of the base were marked by upright poles, 3 to 4 inches in diameter, about 12 feet high. During the months of October and November the country around Fort Bayard was menaced by Indians, and several murders occurred which were attributed to them, and numerous instances of horse-stealing. The vicinity of the Florida Mountains having, on previous occasions, been made a rendezvous by the Indians, was considered dangerous for small parties to enter. Having information from Captain Beyer, the commanding officer at Fort Bayard, that a scouting party would be sent to the Florida and the Hatchet Mountains, I determined to accompany the command, as far as possible, on this trip. Atlas sheet 90 A, a portion of which is cut off on the south by Old Mexico, was surveyed from the eastern slope of the Florida to its western line, and in addition the northern portion of the Hatchet Range, the eastern slope of the Las Animas range, and a strip of country in the eastern part of 89 B. The party left Apache Tejo for this trip on the 5th of November, joined Captain Beyer's command that same evening at Hot Springs, and remained with it until the 15th, when we had reached the Hatchet Mountains. The route of the party was from Apache Tejo to Fort Cummings, over the stage-road. Two days' detention was caused at Fort Cummings by a heavy rain-storm. From this place a route was taken (with a by-road only for a few miles) across the valley of the Mimbres, (here dry) to the Black Rock Tanks at the north end of the Floridas, failing to find lake-water as had been anticipated, in the bed of the Mimbres. Meanders were run along the foot of the slope on either side of the Floridas, and four points in the range occupied. From Las Tinajas, near the south end of the range, we crossed a low flat valley, that has been supposed by many to be the bed of the Mimbres, into the Tres Hermanas, and thence crossed another valley west to Carrizillo Spring, on the old road south from Carrizillo Spring into Mexico. Observations were made at the Mexican boundary monument, four and one-eighth miles south of the spring, so that our work can be connected with that of the boundary survey. From Carrizillo Spring Mr. Nell, with a small party, returned to Apache Tejo over the wagon-road, and, arriving several days before the rest of the party, made the second measurement of the base with the result given above.

From Carrizillo Springs Hatchet Peak was made the objective point for the rest of the party. We proceeded along the main road, and crossed the right angle of the territory of old Mexico, there made by the boundary line, to the east slope of the Hatchet Mountains; thence, after occupying the peak, followed the road to the Eureka mining district, to Carrizillo Spring and to Apache Tejo.

November 23d, the base work being completed, Mr. Nell, with a portion of the party, took route up to the basin of the Mimbres to its head, and afterwards completed the survey of the branches of the Gila within our area. The course of the Gila was followed from the mouth of Agate Creek to about the mouth of Black River, and thence the trail to the Sapillo. From the Sapillo to near Pinos Altos they had a dim trail through the Diablo Mountains, arriving at Fort Bayard December 7. Meantime Mr. Gillette finished the topography about Pinos Altos and Georgetown and intermediate, embracing there the southern slope of Diablo Mountains to the summit, points of which were occupied. A portion of the time I was engaged in obtaining statistics of mining operations in the vicinity. Mr. Lyon started east from Fort Bayard November 25, Mr. Gillette and Mr. Schleicher December 6, and on December 9 Mr. Nell, Mr. Hasson, and myself, the party having been disbanded December 6 to 8, in accordance with your instructions. Much of the minutiæ of our work, including the meteorological work, the routes traversed, the camps made, triangulation and topographical stations occupied, with the instrumental work incident thereto, and the various detours to points of interest, are omitted from this report. It is believed that the field and office records and the completed sheets will best elucidate these details. The survey of a good portion of 84 A, nearly the whole of 84 C, and more than half of the part sheet 90 A was carefully made, in addition to the special trip to the Little Colorado.

SUMMARY.

The party was in the field 128 days.

The main triangulation stations occupied were as follows, viz:

1. Eagle Peak, near south end Tulerosa Mountains.
2. Cook's Peak, highest point Cook Range, near old Fort Cummings.
3. Florida Peak, highest point Florida Range, near north end range.
4. Hatchet Peak, highest point Hatchet Range, near north end range.
5. Bear Peak, high point about 8 miles north of Silver City.

The base development stations were four in number. Bear Peak and two of these last-named stations were visible from the astronomical monument at Bayard. The proper connection was thus made. In occupying the main stations care was taken to connect with Thompson's work, 1873, under Lieutenant Hoxie, Maxson's work under Lieutenant Morrison, 1877, and current year under Lieutenant Griffin, as also to observe points to the westward with a view to connection with triangulation in Arizona.

In addition to the above, the principal topographical stations (which were also either secondary or tertiary triangulation stations) occupied were as follows:

No. 3. Wooded point, west Shaw's ranch.
No. 6. Belle-view Bluff, near Barenda Creek.
No. 7. Peak near Cuchillo Negro, south of cañon.
No. 8. Peak in forks Cuchillo Negro.
No. 9. Peak near head Cuchillo Negro.
No. 10. Peak connecting divide near head Gila.
No. 11. Peak near head Gila.
No. 12. Peak east slope Mimbres, between Cuchillo Negro and Palomas Creek.
No. 13. Peak east slope Mimbres, near Animas Creek.
No. 14. Animas Peak, near Hillsboro', north.
No. 15. Peak between Animas Peak and Hillsboro', north.
No. 16. Peak east slope Mimbres between Apache and Whitewater Creeks.
No. 18. Peak, main ridge Mimbres near head Whitewater Creek, (cone shaped.)
No. 19. Signal-rock, near Whitewater Creek.
No. 20. Peak, near head Jara Losa Creek.
No. 21. Roblado Peak, near Fort Selden, (north point.)
No. 22. Picacho, opposite Las Cruces, near Rio Grande.
No. 23. Peak, Magdalena Range, near Mason's ranch, south.
No. 24. Peak, Goodsight Range, north of road to Cummings from Slocum.
No. 25. Peak, Cook's Range, south of Cummings's road.

No. 27. Peak near Macho Springs, west.
No. 28. Hurricane Bluff, on divide near road Macho Springs to Brockman's, north.
No. 33. Bluff near Black Rock Tanks, Florida Range.
No. 35. Peak near Las Tinajas (south), Florida Range.
No. 36. Peak near Niggerhead Spring (north), Tres Hermanas Mountains.
No. 37. Peak in range of hills near Luera Spring, east.
No. 39. Peak highest point Horse Mountains, north.
No. 40. Crater near Virgil's ranch, Little Colorado, Arizona.
No. 41. East Peak, group near Horse Spring, south.
No. 42. Round Peak, cone divided between San Augustin plain and Gila.
No. 44. Rancheria Peak, (high), south end Florida ranges.
No. 45. Hill near Carrizillo Spring, south.
No. 46. Cone in group south from Cow Spring, Carrizillo road.
No. 48. La Lacha Peak, highest in Animas Range, near Eureka mining district.
No. 49. Pinos Altos Peak.
No. 50. Cone between Pinos Altos Peak and Bear Peak.
No. 51. Black Peak, highest point Diablo Mountains.
No. 52. Peak at Hanover copper mine, north.
No. 53. Hendrick's Peak, near Magruder's, northeast.
No. 56. Thanksgiving-day Peak, near head Miembres.
No. 57. Peak on continental divide, near head Agate Creek.
No. 58. Bluff at Gila, opposite mouth Agate Creek.
No. 59. Bluff at Gila, opposite mouth Black River.
No. 60. Bluff near trail between Gila and Sapillo, west.

Number 60 was the last station occupied, and number indicates the total of topographical stations, in which is included all of the triangulation stations except three.

No. of monuments built	32
No. of bases measured	1
No. of azimuths determined	1
No. of three-point stations	184
No. of variation needles by observations on Polaris	40
No. of sextant latitude stations	34
No. of camps (main and side.)	154
No. of miles meandered	2,509
No. of meander stations	2,273
No. of miles traversed but not meandered	990
No. of cistern-barometer stations	186
No. of aneroid-barometer stations	1,221
No. of mining localities visited	11
No. of hot or mineral springs visited	7
Rio Grande River gauged, times	2

DESCRIPTION.

The north and south tier of atlas-sheets 84 A, 84 C, and 90 A, embraces the country immediately west of the Rio Grande, in Southwestern New Mexico, except a small area north and west of El Paso, from the thirty-fourth degree of latitude (a little south of Socorro on the Rio Grande) to the Mexican line, and extends west to the meridian of Silver City.

The Rio Grande River, cutting into the two northern sheets, leaves a small part of each on its eastern side.

This country may well be remarked for the diversity of its natural features, and, except for the sandy belt immediately along the Rio Grande and the lowest parts of the San Augustin plain, for an almost entire absence of barren soil.

Its resources in grazing land and fine timber are excellent; its mineral resources varied and valuable. Agriculture, in common with our Western territory where irrigation is required, is confined to the immediate vicinity of the streams. The part that can be used for planting is very limited, since where water is plentiful ground available for irrigation is scarce, and in the plain country flowing streams are lacking.

The country is naturally divided as follows: Into the San Augustin plain; the San Mateo and Mimbres Ranges, and the country west of this latter and south of the San Augustin plain, comprising the mountain region; the Rio Grande slope; the broken region extending east from Cook's Range to the river and embracing the Goodsight and Magdalena mountains; while south of these and the mountain region a generally open plain extends south to the Mexican line.

The San Augustin plain, opening to the northeast, and to which access may be had by roads leaving the Rio Grande at the mouth of the Puerco, at Alamillo, at Socorro, at Fort Craig, and by the Cañada Alamosa, lies partly in the northern portion. It will be recalled that the Tulerosa Pass connects this plain with the San Francisco River to the southwest, and the Mangos Pass gives passage to the Little Colorado.

The greater part of this plain is well adapted for grazing; good water is to be found only in the springs in the foot-hills that surround it, and the supply, though limited, is yet sufficient to support numbers of cattle; Monica, Encinosa, and Horse Spring, and the Cienega at Patterson's each give a copious supply; Pueblo and Luera, now weak, can be much improved by digging. Of the first, all were occupied at our coming except Encinosa, Pueblo, and Luera. A flat of low, marshy ground, very alkaline, exists where the waters of the Cienega reach the drainage line of the valley. I found it impracticable to cross this with animals.

The San Mateo and Mimbres Ranges, running generally parallel to the Rio Grande, leave an open country some twenty miles across, sloping to the river from their foot-hills. Peaks of the San Mateo were occupied by Lieut. Morrison's party in 1877, and that region, together with the Rio Grande slope as far south as to include the Cuchillo Negro, will be found described in his report of that season's work.

The Rio Grande slope continues south from the Cuchillo Negro until it merges into "the broken region" south of Mule Spring, where is a pass that separates the Mimbres and Cook's Ranges. Numerous streams have their rise in the Mimbres, and flow eastwardly toward the river; scarcely any of their waters reach it except during the rainy seasons. The ground is of sedimentary formation. A characteristic of the larger streams, when clear of the mountains, is their channels, which are deep cuts, with almost vertical sides a hundred or more feet deep and several hundred yards across, presenting insuperable obstructions to road building athwart them. The most important are Palomas, Arroyo Seco, Animas, Perchas, and Apache. At the mouth of the Palomas is a Mexican town of the same name. The recently established mining town of Hillsboro is on the Perchas, in the foot-hills. Except this, only a few settlers are found away from the river; a little mining camp is on the Animas, about ten miles above its mouth, while near the road leading from Hillsboro to Mule Spring *four settlers* are established.

The foot-hills of the Mimbres are rocky and steep; a slide seems to have occurred, which has left a valley between the main ridge and the foot-hills, through which latter the streams cut in narrow rocky cañons. Good grazing is to be had, which has heretofore been principally devoted to sheep.

The vicinity of the Rio Grande presents little of interest; the Caballo range, bare and rocky, forms a barrier along the east side, so that there is no road crossing the river between Fest's and the ford, 10 miles above Selden. On the west side a road follows the bank, and much of the freight for Fort Bayard, Silver City, &c., passes this way, crossing from the east side at Fest's ferry, and leaving the river at Cottonwood ranch: thence to Macho Spring the road passes through an undulating country, sandy near the river. From Macho Spring the road goes to Mule Spring, where the right-hand fork may be taken to Georgetown via Brockman's Mill, or the left, which leads via Hot Spring to Fort Bayard or Silver City. This is the shortest practicable route to these points from Socorro. From a little below the mouth of the Animas a road leads to Hillsboro, and thence, as before mentioned, to Macho Spring, where it joins the freight road; south of this road the vicinity of the river is sandy, few persons living there. Where the river was gauged at Palomas, September 19, 1878, the width is 465 feet, and the greatest depth only 2.1 feet. At Fort Selden the width is 368 feet and the greatest depth (October 3, 1878) but 2.2 feet. It is remarkable for its shallowness: but more than this is the fact that within a couple of years the river-bed between Mesilla and Fort Bliss has been found for a distance absolutely without running water. This perhaps better than anything else will indicate the sandy soil through which it has to struggle, but of course a good portion of the water of the already shallow river is used in the irrigation of land about the large towns of Mesilla and Las Cruces.

From Santa Barbara below Cottonwood Ranch a road leads past Mason's Ranch to old Fort Cummings, but the distance between Mason's and Cummings is without water.

At Mesilla is the junction of the government telegraph-lines from Santa Fé, from Southern Arizona, and from Texas via Fort Bliss. Stage and mail routes follow the same directions. The western route, which is the southern mail-route to the Pacific coast, leads to Fort Bayard and Silver City; thence across Southern Arizona. Between Mesilla and the Mimbres River it crosses directly the Magdalena, the Goodsight, and the Cook's Ranges, which are nearly parallel.

The Magdalena and Goodsight are low, dry ridges, and the country about them and intervening from the Rio Grande to Cook's Range is dry and uninteresting. Near the river it is sandy; west the grass is good, but there is no timber, and water is exceedingly scarce. Slocum's Station, or Mason's, on the road from Mesilla, between Santa Barbara and old Fort Cummings, affords the only permanent water. Macho and Mule Springs belong to the drainage at the south end of the Mimbres Mountains. Cook's Range, so named from the prominent peak which forms the central figure, is but an extension to the south of the ridge of the Mimbres. Old Fort Cummings, where there is a splendid spring, is at the east base of the range. It has been abandoned for several years. Where the road crosses the summit a mound of earth marks the burial-place of a party of emigrants, who were surrounded and killed by Indians some years since. Mines have been located on the summit of the ridge about 2 miles to the north of the peak. The drainage from the range is west and south into the basin of the Mimbres.

The mountain region, which will be taken from the San Augustin plain south to include the Santa Rita Hills and Lone Mountain, is interesting and important.

The Gila and Mimbres Rivers head in it. The first receives its tributaries from the Mimbres Mountains on the east and the Mogollon on the west, and flows southwestwardly, cutting in a deep, narrow gorge the Diablo Mountains, which, a little north of Fort Bayard, trend westwardly athwart its course and inclose the headwaters of the river in a mountain basin, which is troughed by deep precipitous cañons in as many different places as there are flowing streams. The Continental divide northward from Bear Peak, near Silver City, makes a double curve. First bending to the northeast, it separates the Gila from the Mimbres River, and with the Mimbres Mountains merges into a single ridge of wooded hills that lie west of Ojo Caliente. From a northward direction there it changes to the west and passes in a great curve around by the south and west of the San Augustin plain. A divide to the Mogollon Mountains incloses the headwaters of the Gila, while at Tulerosa Pass and at Mangas Pass we find the main divide in its course to the north.

A grassy, rolling country with dry drains characterizes the northern portion of the Gila basin; then heavily-wooded country begins, with water-courses and deep cañons. Except a couple of ranches on the Sapillo there are no settlers on the Gila or its tributaries above the gorge of the Diablo Mountains. The Mimbres River heads about latitude 33° 10′ and flows nearly directly south, sinking at average water about 4½ miles below the town of Mimbres, on the Mesilla and Bayard road. At the crossing of this road (November 5) the river was about 12 feet wide and 6 inches deep. A number of settlers are located along the river to McKnight's Ranch, about 30 miles above this road.

In the southern part of these mountains is a tract of country about 20 miles square, of which Fort Bayard is nearly the geographical center, which embraces, besides Silver City, Georgetown, Pinos Altos, Lone Mountain, Santa Rita, and Upper Mimbres, at all of which except Silver City mining interests predominate. Extensive gold, silver, iron, and copper mines have been opened.

Of the plains lying between this country and the Mexican line, I desire to call attention to the large extent of fine grazing land now lying idle there, and to express, as I believe, the well-founded hope that advancing population will one day bring to the surface the underlying water, which will, in connection with the fresh-water lakes to be found in many places after rain, afford means for maintaining there large herds of cattle.

The generally level or slightly rolling country is separated from the Rio Grande by the Portrillo Mountains (a low range of hills); and is broken by the Florida and Tres Hermanas Mountains and several low groups in the western and southwestern part.

The drain of the Mimbres River, generally represented on maps as being west of the Floridas and between that range and the Tres Hermanas, passes instead by the north and east of the Floridas toward Pigeon Lake in old Mexico.

After two days' heavy rain, when, in many places on the level, the ground was too soft to travel over, we crossed the bed of this river in passing from Fort Cummings to the north of the Floridas, and found it quite dry, and somewhat indistinct. Cistern barometer measurements showed this crossing to be about 50 feet lower than the lowest point in the flat between the Floridas and the Tres Hermanas. From the summit of Florida peak, too, it is quite easy to trace the dark line of mesquite bushes that grow most plentifully in the dry bed of the river, and show it passing to the north of the Floridas. The Floridas, a short sharp ridge rising some 2,000 feet above the plain, form a prominent land-mark. There is no timber on these and very little wood; water, too, is found in very limited quantities.

The trail which was made by Captain Beyer's command will undoubtedly remain distinct for years. Following it from old Fort Cummings, the first water will be found at the Black Rock Tanks; next a seeping spring (dry during a part of the year); then about the middle of the range a spring about one-half mile west of the direct trail is to be found flowing over white rocks, and where there is at least a little water throughout the year. Again, in the cañon from the southern to the southeastern high point of the range two living springs are near its head, and near where it opens into its first valley running water will be found, in the bed rocks, in the wet season, and water in rock cavities at other times, though I do not think the supply would warrant permanent settlement. These waters are on the eastern slope. No permanent water is known on the west side.

These contiguous sharp peaks to the southeast, though much lower than the Floridas, readily mark the Tres Hermanas. West of the peaks is a group of hills of limited extent, whose foot-hills on the south barely reach the Mexican line. As in the Floridas, a few stunted trees only are growing. The trail leads to the Niggerhead Spring, in the midst of the hills, in a cañon draining to the south, the only permanent water known in the group. In several other places water may be found in holes after rain.

West of the Rio Grande our routes into old Mexico lead south from the vicinity of Fort Bayard. At Cow Spring, some 50 miles north of the line, the road converges from from the Mesilla road at the town of Mimbres and Hot Springs, and from Fort Bayard and Silver City, where there is a custom-house officer. A little south of Cow Spring the road forks; that to the left, and which has been long in use and much traveled, passes by Carrizillo Spring. After rain, water may be found near this road in two places between Cow Spring and Carrizillo. South from the latter spring the road soon passes into old Mexico.

The right-hand road has been established within a few years, and since the opening of the silver mines at Eureka, south of the mining camp, it crosses at an acute angle the international line where the latter runs north and south, and joins with the Carrizillo road at El ojo de los Mosquitos, in old Mexico.

The grade and bed of both these roads is good, and there is little difference in distance, wood and water on both being equally scarce.

HOT SPRINGS.

Adjacent to the Silver City and Mesilla road, where the mountain slopes merge into the plains, is found *the* Hot Spring of Southwestern New Mexico. It is 21 miles from Fort Bayard by the military road. There is also a warm spring at Apache Tejo, and a third one near the first (a little west), and a fourth in the hills east of and near the Mimbres River, some 10 miles south of Upper Mimbres. The temperature of Hot Spring is very high. The water rises in a circular opening at the summit of a small knoll, which has been formed by mineral deposited from the water when it overflowed about the spring. The same formation is now going on in the troughs which conduct the water from the spring. A neat house is kept, with bath-rooms. The curative properties of the water are said to be great. The temperature of the spring at Apache Tejo is 89°, there is a copious flow of water, and when cooled the water is excellent drinking. The temperature of the other two springs is respectively nearly 150° and 120°. Both are copious.

During the ensuing summer the Atchison, Topeka and Santa Fé Railroad will be completed to Las Vegas, New Mexico. From that place to Silver City the distance by freight road, via Anton Chico, Ponta del Agua, to the Rio Grande at La Parida; thence by Socorro, Fests and Cottonwoods, and Macho and Hot Springs, is 357 miles. From Las Vegas via Anton Chico, Tigeras, Albuquerque, Socorro, &c., the distance is 30 miles greater. To Georgetown by going up the Mimbres River the distance is 343 miles, or 14 miles less than to Silver City. The distance from Albuquerque to Georgetown by this route is 246 miles; by the North Star route (leaving the Rio Grande at Lower Sabinal) the distance to Georgetown is 230 miles, a difference of 16 miles in favor of the latter route. This, however, is very hilly, and at present impassible from washouts; and without great additional expense it can never be made even a passable freight road.

MINING INFORMATION.

The working of the mines at Silver City, Pinos Altos, Lone Mountain, Georgetown, and Hillsboro was examined as far as practicable, and the results are submitted on the forms furnished by the office. Some general and special information otherwise collected is given here. As before stated, these towns (except Hillsboro) lie about Fort Bayard as a center.

A general view of this mining region shows a central ridge of granite rock extending from Pinos Altos in a southeasterly direction through Fort Bayard, and containing gold in seams, the direction of these being generally perpendicular to the outcrop.

Near Fort Bayard the gold is found in slate in very narrow quartz seams, as in the Stuart and San José mines. At Pinos Altos in the granite rock the vein matter is more decomposed, and the veins are several feet thick; along the west of this is found slate with overlying limestone, in which the extension of the gold-bearing veins shows silver predominating, as shown in the Langston mine at Pinos Altos and some workings at Central City.

Proceeding further to the west the slate comes to the surface at Lone Mountain and Silver City, and silver is found principally as chloride, in pockets. At the former place the formation is faulty, the slate is found nearly perpendicular, and over it limestone with silver in pockets, while a little to the south of this well-defined veins are found in limestone. The '76 mine in Chloride District (Silver City), owned by Mr. Bremen, affords a most interesting study.

The slate dips to the east (inclined about 75°). The deposit is found between two beds of slate, with pockets occurring at intervals, and a large amount of metal has been taken out. Little method has been observed in the mining, but tunnels have been run in every direction between the beds, sometimes with good results and sometimes without. That this body of ore is connected with a deeper deposit, and perhaps a vein, seems probable, and the present effort of the mine-owners is to develop that by shafts, and at the same time to prove or disprove the theory that similar deposits will be found between beds of slate below, as has been said to exist in similar cases.

Returning again to the east of the granite rock, the adjacent slate carries gold; next, limestone is found. An outcrop in this has been followed to some extent, but not sufficiently to develop a vein. Cubic galena and other forms of lead, with probably some silver, was taken out. Next, to the east of this, occur extensive deposits of copper in carbonate and black oxide, but also extensively red oxide as nearly pure copper, the vein-rock being apparently a soft feldspathic rock. Near Santa Rita an abundance of iron ore occurs with the copper, and alone. The old Hanover copper mine develops the belt at the north, and the Santa Rita at the south.

To the east, again, a ridge of limestone hills intervene to Georgetown, where the abrupt break to the Mimbres River uncovers the slate at the present Georgetown silver mines. The dip of the slate is just the reverse of the strata at Silver City. This superficial vejw of this section is given to invite attention to the apparently symmetrical arrangement of the silver deposits on the flanks with reference to the other metals in the center.

A geological description of this heterogeneous and faulty district (principally in a valley of erosion and almost surrounded by eruptive rock) must be left to the careful scrutiny of a geologist.

GOLD MINING.

Other than the workings at Pinos Altos and Hillsboro, on the Rio Grande slope of the Mimbres Mountains, little is being done at present. A shaft about 40 feet deep has been sunk at Central City, where the surface-rock is granite, on a ledge which promised gold on the surface. The present indications point to silver, but the vein is not yet considered developed. The old San Jadi mine and the Stuart mine, about 1½ miles east of Bayard, are not being worked at present, the seams having been found too small to pay well. The San José has been extensively worked, and is said to have paid well in places. At the Stuart mine an interesting experiment is being conducted by Mr. R. E. Humphreys, who is working the old dump by what is claimed as a new process.

The vein of this mine is well exposed in the shaft, and varies from a mere seam to a thickness of three inches. The ore in the dump has been exposed for several years. It is taken by Mr. Humphreys, and worked in ordinary arrastras; the object of his process being to save the *fine gold*, a well-known source of wastage. This is accomplished, as the work goes at present, by attaching to the revolving upright a double arm, from which copper tubes about one-half inch in diameter and about an inch apart extend downward and dip into the tube; the tubes being coated with mercury, and coming in contact with almost every particle of the fluid, the fine gold is amalgamated, and sinks. Twenty to $25 per ton is claimed to be taken from one dump that was scarcely considered worth milling.

Itı s perhaps unfortunate that ore direct from the mine has not been selected for this experiment, as the disintegrating effect of the atmosphere on the dump has undoubtedly done much to facilitate the separation of the gold (a well-known fact).

In November but one ordinary arrastra was in use. Important details of the process have not been arranged, and cannot therefore be given.

SILVER MINING.

The Eureka silver-mining district, in which the first location was made in May, 1877, lies twenty-two miles north of crossing of the Mexican line, near the west road leading south from Cow Spring, and is about 75 miles from Silver City.

The district was worked with enterprise for a little more than a year. In October, 1878, the only residents were Mexicans—in all about twenty persons.

A small Mexican smelter is erected at the spring, three miles south of the camp. Ore worth about $200 per ton was being taken from the Bonanza Hill near the surface, where the country rock is limestone.

About a mile to the north of this is the King mine and the Tilden lode, parallel veins, and which have been laid bare to varying depth for several hundred feet along the surface, and several shafts have been sunk. Selected ore (about two tons) taken from the King mine yielded at the rate of $286 per ton.

The ores are copper, silver glance, and chloride. Assays have been made giving several thousand dollars to the ton. Other specimens of glance are almost barren. The rich ore, as is almost universal throughout this region, occurs in bunches.

A well has been sunk in an arroyo near the mines, and several adobe houses have been built; of which but one, however, appeared to be occupied.

In Silver City the only mill running was working on tailings, which paid better than the first working of the ores—a fact well worthy of notice. A lead recently opened by J. H. Miller & Co., about five miles northeast of Fort Bayard, contains principally lead; about forty tons of ore have been taken out, but not yet worked.

There is galena and a very friable black, yellow, and brown ore. Specimens of the black have been found to fuse readily in the heat of an ordinary fire.

Orr's mine, located near the summit of Cooke's Range, a few miles to the north of the peak, contains also a very large percentage of lead, and has been used as a flux at the mills. Here is also found an extensive deposit of fluor-spar.

Near the head of Whitewater Creek, on the west slope of the Mogollon Range, deposits of copper (silver) glance have been discovered.

Mr. McEvers's Ranch, some 20 miles south of Hillsboro, is another locality of silver. Work done there, however, during the summer did not give good results.

There are probably 5,000 acres of cultivable land along the Mimbres from McKnight's Ranch south, and fine crops of potatoes are raised, with grain. A scarcity of water is sometimes felt in May and June, which precede the rainy season, belonging to the months of July, August, and September. This land, together with the valley of the Upper Gila (so called), near old Fort West, cultivated to its full extent, will more than furnish staples for the adjoining country. Grass is abundant and need not be cultivated; hay can be cut in any desired quantity from the open plain. Brockman's grist-mill, on the Mimbres, is the only one in this vicinity. A market for lumber would utilize the fine timber so abundant in the Burro and Diablo Mountains and the mountain basins of the Gila and Mimbres Rivers.

The advance eastward of the Southern Pacific Railroad, and the contemplated junction of the Atchison, Topeka and Santa Fé with it, will, it is hoped, soon open the country to railway communication, with great increase of prosperity.

COPPER MINING.

A belt of country lying a few miles to the east of Fort Bayard, and between that place and Georgetown, is rich in copper. Iron is found adjacent to the copper and also with it.

The oldest mines are those at Santa Rita, at present owned by Messrs. Caffee, Moffat, and Dudley & Gill, of Denver, Colo.

I am indebted to Mr. Wm. M. Pierson, agent, for the following brief historical sketch:

The deposits were known to the Indians and surface worked by them. In 1800 they made them known to Colonel Corasco, of the garrison of Hunnas, in Old Mexico. Colonel Corasco sold the mines to Manuel Elga, a merchant of Chihuahua, for $338,000, which amount was borrowed for the purpose from Don Palacio Garia, a banker of the city of Mexico. Elga contracted with the Mexican Government to take all the production of the mines at the rate of 55 cents per pound, and repaid the amount borrowed in three years. In 1828 the Mexican Government (then a republic) issued an order compelling all Castilians to leave the country. Elga rented the mines and went to Spain. McKnight & Cusier were the rentees until 1835, then Sweet & Lacost, of San Antonio, Texas, until 1862, when they were expelled by Federal troops. The mines remained idle from that time until 1873, when they were purchased by the present owners from the heirs of Manuel Elga.

WORKINGS.

The ore was first found in masses near the surface, and was quarried rather than mined. Two of these excavations remain, one about 150 feet square and another 100 feet square and 30 feet deep. Afterwards a shaft was sunk nearly between the two. Up to 1862 it had been sunk 250 feet, and had two series of driftings, one at 125 feet and the second at 250 feet. Each series covers an area of about 500 square feet, and consists of a system of galleries intersecting each other at right angles and distant apart from 15 to 20 feet.

In 1873 work was recommenced. Six months were required to exhaust the water from the mine. A fifteen-horse-power engine was used. This has since been replaced by one of double the capacity, and the latter is now at the works. After exhausting the water the shaft was sunk 50 feet, but without drifting. After working about a year the present company ceased work, owing to the low price of copper and the difficulty of transporting it from Santa Rita to market. The mine has since rapidly filled with water. The present owners have also erected a fine Swansea furnace at a cost of $10,000. The dimensions of the furnace are 11 by 20 feet, and has a capacity to reduce ten tons in twenty-four hours. It has not been used for three years, but remains in good condition.

A controversy prevails as to the quantity of land belonging to the grant. Eleven leagues are claimed.

The deposits of copper cover about one square mile of territory, and probably extend in a continuous belt about two miles to the north along the east slope of the Bayard Basin to the site of the (old) Hanover copper mine.

About half a mile to the north of the Santa Rita shaft are the Chino and Yosemite copper mines, claimed by the Santa Rita Company, but they are held and have been worked by other parties. They were extensively worked by Messrs. Magruder & Fest, but work ceased in 1876 owing to the depreciation of copper.

The Hanover mine above mentioned has not been worked for a number of years. The superintendent was killed by Indians, and the settlement abandoned in consequence.

Near the Santa Rita shaft Mr. Pierson has opened three new prospects. In the first a shaft 6 by 10 feet has been sunk 25 feet on a deposit of mineral. Sixty-five tons have been taken out, which assays show to contain about 70 per cent. of copper and 30 per cent. of iron. In the second there is developed a couple of sedimentary deposits of copper, one 11 feet wide by 2 thick, the other 9 feet wide by 15 inches thick. In the third, surface croppings about 30 feet square containing red oxide of copper, but principally the carbonate, malachite, and azurite in white porphyry, so called.

Red oxide, malachite, azurite, and copper combined with iron (as oxide) constitute the principal forms in which the copper occurs in all these mines, though large masses of nearly pure copper (native) have been found. The native copper is principally found in continuous narrow seams, in a white rock that seems to be nearly pure feldspar. Beautiful specimens of these leaves are taken from the rock when it is broken open. The carbonates occur disseminated through a more friable but somewhat similar country rock. The deposits generally are irregular and do not occur in veins.

Iron is found abundantly over an area about one mile wide by three in length, intersecting the copper ore.

Very respectfully,

ROGERS BIRNIE, JR.,
Lieutenant of Ordnance, Executive Officer.

Capt. GEO. M. WHEELER,
Corps of Engineers, in charge.

APPENDIX F.

REPORT OF LIEUTENANT M. M. MACOMB, FOURTH ARTILLERY, IN CHARGE OF PARTY NO. 2 CALIFORNIA SECTION, FIELD SEASONS OF 1878 AND 1879.

UNITED STATES ENGINEER OFFICE,
GEOGRAPHICAL SURVEYS WEST OF THE 100TH MERIDIAN,
Washington, D. C., September 20, 1879.

SIR: I have the honor to submit the following report of the operations of the parties of the California section under my charge during the field seasons of 1878–'79.

EXECUTIVE REPORT—SEASON OF 1878.

Leaving Washington July 21, I proceeded direct to Carson, Nev., where I arrived July 28th. Lieutenant Symons had already nearly completed the organization of my party in connection with that of his own, and it was ready for the field August 1, 1878, with the following *personnel*: Lieutenant M. M. Macomb, Fourth Artillery, executive officer and field astronomer; J. C. Spiller, topographer; J. H. Morgan, meteorologist; J. B. Callahan, odometer recorder; Charles W. Howell, chief packer; H. Medlicott and N. F. Dow, assistant packers; Alexis Bochet, cook.

August 2 the party was joined by R. Raycraft, man of all work, who was employed temporarily, so that the party could be divided into two effective sections, one for main triangulation and topography, the other for meander work and secondary triangulation, as will be subsequently explained. Total, including myself, nine men.

Our transportation consisted of twelve pack and nine riding mules, with one bell-mare. Total, twenty-two animals.

The instrumental outfit was the same as that usually allowed a party organized for triangulation and topography, and needs no special mention.

The work assigned the party was as follows: First, to carry the triangulation of the previous season far enough westward to connect with that carried out from the Panamint base, as well as joining with the scheme carried eastward as far as Austin, Nev., in 1876, by Lieutenant Birnie's party; then moving westward, to carry the scheme as far down into the foot-hills of the Sierras as possible, so as to close with the work proposed to be carried out from Fresno, Cal.

The area to be worked up topographically lay directly south of that done by my party the previous season, and included the southern part of atlas 56 B, and as much of atlas-sheet 56 D as possible. See Progress Map of 1879.

The season being already far advanced it became a matter of the utmost importance to complete as soon as possible the work in the high mountains, so as to avoid disaster from the autumnal storms. Hence the following plan was adopted:

First. To move southward to Highland Peak (occupied by me in 1877), for the purpose of selecting and sighting points to be brought into our season's triangulation.

Second. To separate into two parties; one, under Mr. Spiller, to carry the triangulation to the south, as previously stated, forming a net of triangles between the crest of the Sierras and the high peaks of the Wassuck and White Mountains. The other, under my personal supervision, to finish the topography in the southern third of atlas-sheet 56 B, the two parties to meet at Bridgeport, Mono County, California, about September 1.

Third. Leaving Bridgeport during the first part of September to strike into atlas-sheet 56 D, carrying the triangulation entirely across it and down into the foot-hills of the western slope of the Sierras.

By arrangement with Lieutenant Randolph, quartermaster of the survey, supplies for two months were to meet us at Bridgeport, for one month at Mariposa, and for another at Sonora, California, if needed.

Accordingly, August 1, the party left Carson, passing south through the Carson Valley, and camped August 3 on Dixie Creek, near Highland Peak. The route was so chosen as to permit the survey of roads and trails not meandered the previous season.

Highland Peak was successfully occupied on the 4th, and on the next day we divided our forces as follows: The side party for triangulation consisted of Mr. Spiller in charge; Mr. Morgan, meteorologist, with Medlicott and Raycraft as packers, the transportation being four riding and four pack animals. As this party would have to make long and rapid marches, only those articles absolutely necessary were taken, the great bulk of the baggage remaining with the main party. Each section took a month's rations. It is worthy of remark that the above organization is all that could be desired for a quickly-moving party, specially destined to to carry on triangulation over a rough mountain country during a field season of four or five months. The number of men, four, is fully large enough to do what is required, and yet could hardly be diminished for any length of time without throwing too much upon individual members. The triangulator, having an intelligent assistant, who records and takes the necessary barometric readings, is enabled to devote his whole time and attention to his sketches and observations, and can in a given period accomplish the largest possible amount of good, accurate work. With two reliable men to cook, pack, and look after the animals, the triangulator and his assistant have opportunities to leave the ordinary route and study the country by side reconnaissances. Moreover, one man may be always left in camp while the other assists on the peak in carrying the instrument, building the monument, &c. A party thus organized could work rapidly and economically, without being overworked, and could collect the best data obtainable with a ten-second transit and a mountain barometer.

The triangulation party being fairly started, I moved up Wolf Creek and over its divide into Hermit Valley on the Mokelumne. From Hermit Valley the Big Tree road was surveyed to Blood's toll-house, connecting here with a meander run by me the previous season from the Big Tree Grove. After occupying a couple of topographical stations, the Big Tree road was followed to Big Meadow Creek and here we turned to the right, running a meander over a stock road as far as the mining village of West Point near the west edge of our area. From this point we traveled northward until the Antelope and Pine Grove turnpike was reached, which was surveyed to its junction with the Amador road at Antelope Springs. The Amador road was now surveyed up to Tragedy Springs, connecting here with the work of 1877. Returning to Antelope Spring the meander was continued to Volcano and thence back to West Point. Going south from this village we passed through Railroad Flat, and then moved southeastwardly over a rough mountain road until the Big Tree road was intersected near Dunbar's sawmill, now abandoned.

The roads and trails in the vicinity of the Calaveras and South Groves of big trees were surveyed, after which the party proceeded to Sonora, via Murphy's, Douglas Flat Vallecito and Columbia, all mining villages. From Sonora the Mono road was followed to Strawberry Flat on the Stanislaus and beyond as far as Niagara Creek, thus giving a complete survey of this celebrated route between the western foot-hills and the Aurora and Bodie mining districts. Owing to the recent rich developments at Bodie everything looked cheerful and busy along the route, and the through line of stages put on during the summer was doing a thriving business.

The time between August 20 and September 2 was spent in finishing the topography of the block of country lying south of the Sonora and Mono road and north of the old "Relief" Trail. Castle Rock, Grizzly Peak, and four other points were occupied for topography and the Relief Trail meandered from Strawberry to Leavitt's across the mountains.

September 2, found me in Bridgeport, but, as the other party was not yet in, I occupied for topography Buckeye Peak and a point to the north, both prominent points in the montains west of Bridgeport.

On my return I found that the other party had arrived after a remarkably successful trip, a very satisfactory set of observations having been obtained.

After our separation on August 4, Mr. Spiller proceeded by the most direct route to Cory's Peak, and completed his work from this station August 10. This peak is one of the points in the scheme of triangulation being carried across the interior by the Coast Survey. Their station was not made on the summit, but at a more convenient spot to one side.

The next point visited was McBride's Peak, the most prominent northern point of the White Mountain range, and after that White Mountain Peak, the highest point visited during the season. A high point of the Sierra Nevada, near Mount Abbott, was also selected and occupied, and finally, September 2, the mission of the side party was completed by the occupation of Mount Dana, north of the well-known Bloody Cañon trail.

On meeting at Bridgeport we decided that it would be necessary to reoccupy Sonora Peak. This was done by Mr. Spiller September 10. Meantime I made a trip from Bridgeport down the East Walker to Hoye's store, on the West Walker, and returned by the cañon of that stream, surveying the new road then being built from Coleville to the Mono road. September 12 we left Bridgeport and prepared to take up the mountain work and topography of Sheet 56 D. We ascended the valley of Virginia Creek and camped near its head, for the purpose of occupying what is locally called Castle Peak, but which we named Dunderberg, after the mines of that name upon its northerly slope, desiring to avoid duplicating the name which we had already given to the castellated volcanic mass north of the Central Pacific Railroad near Summit Station.

Owing to bad weather we were detained in the neighborhood of this peak until September 19 before we finally completed our observations. During this time snow fell nearly every day. Previously we had been remarkably fortunate as to weather, and had been able to work continuously, but now it seemed as if the elements had determined to combine against us and prevent our finishing our work. From this time on I determined to make every effort to get our main triangulation at least well done, even at the sacrifice of the topography. Our next important point was Mount Conness, on which we completed our observations September 24. From our camp at the base of Mount Conness we moved to the Tuolumne Meadows, *en route* to Mount Lyell. This we succeeded in ascending after a hard climb, only to find all our trouble rendered fruitless by the clouds and chilling mists which hung about the summit, absolutely precluding the taking of any angles. Not being able to spare any time waiting for better weather, we returned to the Tuolumne Meadows and completed our meander work and made one more topographical station.

On the 29th it snowed nearly all day, but the 30th was clear enough for topographical work. Taking advantage of this we made two stations and moved camp to the Cathedral Meadow and the next day occupied the highest one of the Cathedral Peaks, and another.

October 2 and 3 were spent upon Cloud Rest and a couple of minor points, and October 25 we entered the Yosemite Valley. Mr. Spiller at once took up the survey of the existing roads and trails, while I prepared for a trip to Mount Lyell, the weather now being favorable for its occupation. After a hard day's work interrupted greatly by heavy winds, I at last succeeded in getting the necessary angles and on the following day, by a forced march of 35 miles, returned to the valley. We now prepared to make a complete circuit of the valley by the old Mono trail on either side, but on the 14th, in camp on the head of Cascade Creek, were overtaken by a heavy snow-storm, which gave us 14 inches of snow during the day and night. This made it impossible to continue our trip, as every blade of grass was covered so as to prevent our finding feed for our animals. We were therefore obliged to return to the valley, but, as it was absolutely necessary that Mounts Hoffman, Clark, and Merced should be occupied, Mr. Spiller and myself started out with two men and a few pack animals and worked our way through the snow, which was melting rapidly, and succeeded in completing our task on the 26th.

Tower Peak being now the only high point remaining to be occupied, I thought it best to attempt it at once. A conversation with an old hunter in the Yosemite led me to believe that the peak might be reached by following up some one of the long ridges running northeasterly from the Hetch-Hetchy Valley. Accordingly a main camp was established here and several attempts made to find a practicable route. The country turned out more broken and intricate than I expected, and the threatening nature of the weather, combined with the time of year, made it unwise to attempt the topography of this desolate region, so that I determined to withdraw and take up the triangulation in the western part of our area. On our return from the Hetch-Hetchy, Wade's Peak was occupied for triangulation and topography, the survey of the Coulterville road completed from Hazel Green to the Valley, and that of the Mariposa road finished as far as Cold Spring Station.

From Cold Spring I sent on to Mariposa and replenished my stock of rations, Devil's Peak being occupied meantime for triangulation. I now moved to the southeast corner of our area where Chiqnito Peak was occupied, as well as Deadwood, near Fresno Flat. This peak lies just south of the southern line of our area, and was occupied to assist in connecting with the work from the Fresno base. All the meander work which could be done in the limited time at our disposal was looked to, but it was held subservient to the triangulation.

The 28th of November, Thanksgiving, was spent in Mariposa. Letters of instruction received here from you ordered me to disband in Sacramento not later than the 17th of December. From this time on, therefore, the work was hurried as much as possible, Green Mountain, our most southerly point, being occupied December 2, and Schultz Mountain December 6, the party returning to Mariposa on the 7th. From this town we proceeded north through Bear Valley to Coulterville, and thence down Moccasin Creek to Culbertson's on the Big Oak Flat road.

Moccasin Peak, near here, was visited on the 10th, but we were unable to take a complete set of angles, owing to heavy timber and misty weather. On arriving at Sonora the following day letters from Sacramento ordered the party in at once, and accordingly the 13th found us at Milton on the Stockton & Copperopolis Railroad, whence the party was transported by rail to Sacramento, and there disbanded on the 14th of December.

The party was in the field 135 days and made in all 100 camps The following list shows numerically the principal observations made:

Number of points occupied as primary triangulation stations	22
Number of points occupied as secondary triangulation stations	14
Number of points occupied as three-point triangulation stations	163
Number of meander stations	2,975
Number of miles meandered	899
Number of miles traveled without meander	1,493
Number of cistern-barometer stations	216
Number of aneroid-barometer stations	858
Highest altitude reached (approximate) feet	14,100
Lowest altitude reached (approximate) feet	171

During the first part of the season the weather was generally favorable and the party worked very rapidly, our travel from August 5 to September 5 being over 1,000 miles.

I desire to express my thanks to all the members of the party for faithful and cheerful performance of their respective duties during the entire season, and would especially commend Mr. Medlicott for his skill and daring in climbing mountain peaks.

EXECUTIVE REPORT—SEASON OF 1879.

The field season this year was unusually short, it not being possible to carry on the field work after June 30, owing to lack of funds. It was possible, however, even in the brief time allotted, to collect a large number of important data relating to the topography in atlas-sheet 56 D, as well as to complete the angular measurement of the triangles having apices at Blue Mountain and Moccasin Peak, two important primary stations selected in 1878. All the work to be done was subsidiary to that assigned my party in 1878 and lay in the same area.

Under your orders I left Washington May 5, with Mr. Maxson as assistant, and reached Sacramento May 12. All the members of the party joined here and the organization was completed, so that the entire party, men, animals, and *matériel* could be sent on the 14th to Oakdale, terminus of the southern branch of the Stockton and Copperopolis Railroad, and the most convenient point from which to start our season's work.

Arriving here late on the evening of May 15 we were obliged to spend the 16th in determining the "per mile" of the odometer, adjusting instruments, fitting aparejos, making up the packs, in short taking all the precautions necessary to enable the work to be carried from the start to the finish without unnecessary delays. The organization of the party was as follows: Lieutenant M. M. Macomb, Fourth Artillery, executive officer; F. O. Maxson, topographer; Corporal F. J. Hill, Fourteenth Infantry, odometer recorder; B. P. French and Charles W. Howell, principal packers; Henry Sayre, assistant packer, and Delancy Willson, cook; total, seven men.

The transportation consisted of seven riding and nine pack animals, with one bell mare and one extra mule; total, eighteen animals. We carried rations for forty-five days.

Owing to the large amount of work to be done and our limited time the party was so organized as to admit of being split into two sections, the plan of operations being as follows:

The party was to work together for about eight days surveying the roads in the plains and getting the topography of the foothills in the western part of the area, the presence of snow making it unwise to advance at once into the high country to the east.

Next, to divide our forces, Mr. Maxson with three men was to finish the important topography left undone the previous season; while I, with the remaining two, was to complete the triangulation by the occupation of Moccasin and Blue Peaks, and, if the absence of snow permitted, Tower Peak in the main Sierra, obtaining at the same time all the topographical data possible.

Accordingly, on the 17th of May the field work was begun by running a line to Roberts' Ferry on the Tuolumne, just where it leaves the western edge of our area. The ensuing week was occupied in meandering the roads between the Tuolumne on the north and Bear Creek on the south and studying the topography of the adjacent foothills. Mr. Maxson and myself generally ran independent lines, one taking the odometer, the other working by time and three-point stations. The villages of Snelling and La Grange, Hornitos, Indian Gulch, Chinese Camp, and Jacksonville were visited and all the important thoroughfares surveyed, leaving only those which we could easily complete on our home trip. The 25th of May found us encamped at Marshall's Flat near Moccasin Peak. This point Mr. Maxson and I visited together and from here I pointed out to him our principal stations of the previous season, with which he was to connect his work, and explained to him as well as I could the character of the country he was about to enter. That evening I furnished him with a letter of instructions laying down the camps and marches for each day up to June 19th, when we were to meet in Sonora, where I was to receive definite orders as to time of stopping work. It was of course understood that Mr. Maxson was to use his own good judgment in varying the plan laid down for him, whenever swollen streams, deep snow, or other unforseen contingencies rendered it advisable.

Accordingly, May 26th Mr. Maxson and party broke camp at Marshall's Flat and I saw no more of them until our rendezvous at Sonora.

The first work done was a survey by three-point stations of the ridge running southeasterly from Moccasin Peak to the Coulterville road, camp being made at Haigh's, two miles above Coulterville. From here the route was by the old Boneyard road to Black's; thence by trail to Hennessey's bridge on the Merced; then to Hite's Cove, and the southward to Fresno Flat, which was reached May 30. From this village the route was over the northern part of the newly constructed "Madera and Yosemite Turnpike," which was carefully surveyed. The next march was to Chiquito Meadows, and the Chiquito Joaquin via the old Long Valley trail, which was surveyed to the eastern edge of our area. Several days were spent in studying the topography in this vicinity, the party returning to Clark's on the 6th of June.

The well-known old trail from Clark's to the Yosemite was then surveyed, and that valley itself entered June 9 by the Glacier Point trail.' Two days were spent in carefully determining by theodolite the altitudes and relative locations of all the prominent points about the valley, and then, until June 15, the time was occupied in gathering topographical details north of the Yosemite.

The trail down the Merced Cañon to Hennessey's was then surveyed and a line run over an Indian trail to Hazel Green, on the Big Oak Flat road. The survey of this thoroughfare to Culbertson's, on Moccasin Creek, was then made, connecting here with our previous line from Jacksonville, on the Tuolumne. From this village a line was run, via Kincaid Flat, to Sonora, which was reached June 19, thus completing the plan of operations assigned Mr. Maxson's party in May.

While this work was in progress I proceeded with the triangulation and topography from Moccasin Peak, where I was delayed two days on account of bad weather and heavy timber which had to be cleared off

I then started for Blue Mountain, running time meanders over roads not previously surveyed, and completed the triangulation from this point June 4.

The high Sierra appeared so snowy that I knew it would be impossible to reach the summit of Tower Peak for perhaps a month to come, but as there was still considerable topography in that direction to be studied, I hoped to be able to gather some important features before our time was up. I therefore returned to Sonora and followed the Mono road as far as Bradford's sawmill, where I turned off to the right and followed a stock trail, which brought us out in Cherry Valley, through which runs Cherry Creek, a large stream draining into the Tuolumne from the north.

. I was delayed here a couple of days by rainy weather, but on the 12th started up the ridge on the east side of the valley, hoping to be able to reach some of the minor points southwest of Tower Peak, if not the peak itself. I was accompanied by Mr. Thomas Richardson, who has a sheep range in Cherry Valley and vicinity, and who is perfectly familiar with the rugged country south of the Relief trail. After we had reached an altitude of about 8,000 feet above sea level, the snow became so deep as to effectually bar our progress. Seeing that it would be folly to attempt anything further in this direction, I determined to spend the few days still at my disposal in studying the topography in the neighborhood of Lake Eleanor and the Hetch-Hetchy Valley. This work occupied me until the 18th of June, when I started for Sonora, reaching that town the following day, and there met the other section of the party under Mr. Maxson.

Instructions received here from you informed me that it would not be necessary to reach Milton, our disbanding point, before the 27th of June. This gave us another week in our area, and this time was profitably employed in meandering roads and gathering topographical details to the south and west of Sonora and in making a secondary triangulation station on the southern and highest point of the Bear Mountain Range, about six miles northeast of Copperopolis.

This practically completing our field-work, the party was marched to Milton on the 27th, and the following day transported by rail to Sacramento and there disbanded. Thus ended a short but profitable field season, during which time all the members of the party displayed the warmest interest in the work. Messrs. French, Howell, Sayre, and Willson more than sustained their previous good reputation for steadiness and hard work, and Corporal Hill, Fourteenth Infantry, was all that could be desired as odometer recorder. Too much praise cannot be accorded Mr. Maxson for his unflagging energy and practical knowledge of his work, which, continued, enabled him to collect a vast amount of map material in the short time allowed us.

We were in the field forty-two days, during which time thirty-two main camps were made. An inspection of the following numerical list of principal observations taken will show that our average daily travel was over 34 miles.

Number of main and secondary triangulation stations	3
Number of three-point stations	154
Number of meander stations	2,325
Number of variations determined	36
Number of cistern barometer stations	48
Number of aneroid barometer stations	659
Number of miles meandered	833
Number of miles traveled without meander	599
Total miles traveled	1,432

TRIANGULATION.

The main points on which our triangulation depends, with their altitudes as far as determined, are:

Highland, 10,956 feet, main point of Silver Mountains near Silver Mountain City, California.

Cory's, 11,326 feet, main point of the Wassuck Mountains west of Walker Lake, Nevada.

McBride, 13,443 feet, most northern peak of White Mountains east of Owen's River, California.

White Mountain Peak, 14,200 + feet, highest peak of White Mountains east of Owen's River, California.

Morgan's Peak, ——— feet, high point of the Sierras near Mount Abbott, California.

Dana, ——— feet, high point north of the Bloody Cañon trail.

Sonora, 11,479 feet, northeast of the Sonora Pass, California, on Sonora and Moon road.

Conness, 12,518 feet, prominent granite peak northwest of Mount Dana.

Lyell, 13,191 feet, culminating point of the divide between the Merced, Tuolumne, and San Joaquin Basins.

Hoffman, 10,872 feet, at head of Yosemite Creek.

Clark, 11,295 feet, most northerly peak of the Merced group.

Devils', 6,910 feet, north of Cold Spring Station, Mariposa and Yosemite road.

Chiquito, 8,136 feet, on ridge west of Chiquito Joaquin Creek.

Deadwood, 4,451 feet, timbered point near Fresno Flat, California.

Green, 1,352 feet.

Schultz, 2,275 feet, west of Cathey's Valley.

Moccasin, 3,003 feet, prominent timbered point in ridge west of Moccasin Creek.

Blue, 6,076 feet, timbered point on ridge between South and Middle Forks, Mokelumne River.

All these points, with the exception of Blue, were occupied during the field season of 1878. Besides the above points, a number of others were occupied as secondary stations, so that all the topographical work of the area visited is based on an excellent scheme of triangulation. From the main and secondary stations an immense number of points were located by cross-sights. Sights were also taken to prominent points of the Coast Range, such as Mount Diablo, Mount Hamilton, &c., so that their positions can be computed. The area included between the exterior lines of our main triangulation of 1878 is, roughly, 7,159 square miles, and the computations showed a remarkable degree of accuracy in the observations.

This work, it is to be remembered, was done in addition to a large amount of topography, and too much credit cannot be given to Mr. Spiller for his energy and the interest manifested by him in the work. Had it not been for his knowledge of the previous work done and his excellent judgment in selecting points to be occupied, the work could not have been successfully completed within the allotted time.

DESCRIPTIVE REPORT.

The area examined for mapping during the seasons of 1878–'79 includes the southern part of atlas sheet 56 B and all of 56 D, and is immediately south of the work of 1877. It embraces that portion of the main crest of the Sierra extending from the Sonora Pass to Mount Lyell, also the drainage basins of the Stanislaus, Tuolumne, Merced, and part of the San Joaquin Rivers, as well as part of Fresno, Chowchilla, Mariposa, and Bear Creeks. The area presents an immense variety of topographical features, from the rugged and intricate country adjacent the high Sierra to the flat and monotonous expanse of the great San Joaquin Valley.

Two of the most remarkable features—unparalleled, perhaps, in their way—are the deep gorges known as the Yosemite and Hetch-Hetchy Valleys, of which special mention is made further on.

The great timber belt of California runs directly across the area examined, which contains no less than six groves of that giant of American vegetation, the *Sequoia gigantea*. These are the Calaveras and Great South or Stanislaus Groves, those of Mariposa and Fresno, besides two of minor importance on the Big Oak Flat and Coulterville roads, respectively. As we descend from the belt of heavy timber we find large agricultural areas devoted to the cultivation of fruit and some grain in the foot-hills, and almost entirely to the latter in the broad expanse of the great valley. The land not taken up for agricultural purposes is used for grazing during the fall and early spring, after which great numbers of sheep and cattle find an agreeable change of feed in the meadows of the high mountain country.

The foot-hill section has for years been the scene of mining industry which has developed numerous towns, the better known being Sonora, Coulterville, and Mariposa. Although these places have perhaps seen their best days there is still in the foot-hills a vast amount of wealth undeveloped and a number of mines and mills in successful operation. Among these latter is the Hite's Cove mine, examined and reported on by Mr Maxson.

YOSEMITE VALLEY.

This wonderful locality has already been so minutely and accurately described in the various guide-books now published as to render any lengthy account superfluous. The gap that we have filled topographically is comprised in careful surveys of the three great roads into this valley and of the three important trails leading out of it, namely, the Eagle Point trail, the Glacier Point trail, and the Nevada Falls trail, none of which have ever been accurately mapped. Careful barometric determinations have been made for the altitude of the valley, and also a series of observations were taken to obtain reliable altitudes of all the points of interest. Owing to the fact that the final computations have not yet been completed it is not possible to give a full list of these.

As the observations were taken with especial care it is hoped that they will finally settle all disputed points.

THE HETCH-HETCHY VALLEY.

This valley is worthy of especial remark as being perhaps the most remarkable feature of the great Tuolumne Cañon. To those who have time to leave the usual routes of tourist-travel it would well be worth a visit. It may be reached either from Hardin's or Hodgdon's at Bronson's Meadow on the Oak Flat and Yosemite road by very good trails. The route pursued by us was from Bronson's Meadows. The following table gives the distances and altitudes along the trail:

Station.	Miles.	Altitude above sea.	Remarks.
		Feet.	
Hodgdon's	0.00	4,506	Stage station, Big Oak Flat road.
Crossing, south fork Tuolumne	1.18	4,163	Ford.
Wade's Meadows	2.05	4,567	Also called by Meadows now.
Crossing, middle fork Tuolumne	2.00	4,158	Ford.
Hog Ranch	3.00	4,550	Ranch and Meadows.
The Cañon	2.86	4,849	Small cattle ranch.
Cabin, Hetch-Hetchy Valley	5.21	3,489	At foot of trail, west end of valley.

	Miles.
Hodgdon's to Hetch-Hetchy	16.30
Total—Oak Flat to Hetch-Hetchy via Hodgdon's	44.22
Total—Barnard's Hotel, Yosemite, to Hetch-Hetchy	37.65

The trail from the cañon on is rough and steep, but perfectly practicable for horses and pack-animals. Our barometric observations give 3,469 feet as the altitude of the middle of the valley above the sea, or 382 feet below the Yosemite. The total length of the valley is only about 3½ miles.

While it cannot be compared with the Yosemite in size or in grandeur, it perhaps more nearly resembles that valley than any other known locality, and has at least sufficient beauty and individuality to produce an ineffaceable impression on the observer.

The two most striking features are the great dome on the south side of the valley, rising some 2,500 feet above the river, and the magnificent falls opposite. These falls which pour over the north wall of the valley at about its middle are in an angle formed by a great buttress just to the west, which recalls the El Capitan of the Yosemite. While this water-fall is similar in position and effect to the Yosemite it has not the same sheer plunge which is the remarkable feature of that fall. But to make up for this it has a much larger drainage basin which contains some quite sizeable lakes which act as reservoirs, so that in volume and constancy at least it is far superior. In spring and early autumn there is a second fall which is quite noticeable, as it pours over the northern wall farther to the west. The lip of this is about 1,750 feet above the Tuolumne, that of the main fall being 2,000 feet. The high granite bluffs east of the falls rise about 3,090 feet above the valley.

Besides the first trail described, two others leave the valley north of the river, one at either end of the valley; that at the west end passes by a steep zigzag route up a mass of *debris* coming down into the cañon from a glacial moraine above; a ledge of rock on this trail, about 1,060 feet above the river, affords an excellent general view of the valley; the other, leading out at the east end of the valley to a meadow known as "Rancheria" and to numerous other meadows used as sheep ranges. The former trail leads to McGill's meadows, and lake Eleanor, thence to Cherry Valley and on to the Sonora and Mono road at Bradford's saw-mill. After getting out of the cañon on this route, by following a trail forking abruptly to the right, we reach in a few miles a very pretty sheet of water on Hetch-Hetchy Creek, called Lake Vernon by the sheep-owners, on whose range it is; this is the principal reservoir of the Hetch-Hetchy Fall.

After leaving the Lake Eleanor trail we commence to ascend and pass over a very well-marked moraine, its summit where we cross being about 2,760 feet above the Hetch-Hetchy.

One interesting point which we find in the Hetch-Hetchy, and not in the Yosemite, is abundant evidence of glacial action. The glacial polish is very plain on the granite rocks forming the bed of the valley east of the dome, while some hundreds of feet above, the rocks show well-marked horizontal grooves. Fine examples of the same agency occur in the basin of Hetch-Hetchy Falls Creek, and in those of the streams emptying into the east end of the valley from the northeast. This valley was first brought to public notice by the California State geological survey, and is described and mapped by Professor Whitney in his "Yosemite Guide Book."

CHERRY VALLEY AND LAKE ELEANOR.

Cherry Creek drains a large area south of the Relief trail and, in fact, is the largest stream coming into the Tuolumne from the north. Cherry Valley is a large meadow or flat on this creek, its general direction being about north and south. It is nearly three miles in length and varies from a quarter to three-quarters of a mile in breadth. It contains a large extent of fine grass and is claimed by Mr. Thomas Richardson, of Oakdale, and is by him used as a sheep range. When we visited it in the middle of June we found that even the presence of large flocks of sheep had failed to drive off the numerous bands of deer, which the snow still kept out of the high mountains. An alkaline pond about a third of a mile from Richardson's cabin was the nightly resort of numbers of deer. This valley has also for years been the resort of grizzly and cinnamon bear, and several of the latter were seen during our short stay. Two fine specimens had been killed shortly before our arrival. Our barometric observations give 4,615 feet as the altitude of this valley above sea-level. This locality is easily reached by turning off from the Mono road just above Bradford's saw-mill, about five miles beyond Northrup's. There is a rough wagon road as far as Hull Meadows, now Lord's, and from here on a very fair trail much used by sheep and cattle owners. By fording Cherry Creek and crossing a low gap in the ridge east of it we come to Lake Eleanor, a very pretty sheet of water about a mile in length and from half to three-quarters of a mile broad. It is fed by three streams, two coming in at the north, and one at the south end. This lake is claimed by parties residing in Columbia and Sonora, and was by them stocked with trout in the fall of 1877. It now contains a large number of fine fish. By passing around the south end of the lake and fording the creek a trail will be found about half a mile above the ford, which turns up the ridge to the right. This runs to McGill's meadows, and thence to the Hetch-Hetchy Valley, as mentioned under that head. Our observations made the lake 4,630 feet above the sea.

THE RELIEF TRAIL FROM STRAWBERRY TO LEAVITT'S.

This trail is interesting as being one of the old emigrant trails over the Sierra Nevada. It was spoken of as a possible route for a wagon-road when the Sonora and Mono road was projected, but was rejected as too rough, a better route having been found along the middle fork of the Stanislaus. The accompanying table gives the distances and altitudes along this trail.

Stations.	Miles between stations.	Miles from Strawberry.	Altitude above sea. Feet.	Remarks.
Strawberry	....	....	5,238	Stage station Sonora and Mono road.
Burst Rock	9.86	9.86	9,157	
Trail to Cooper's milk ranch	3.75	13.61	....	Cooper's, 3.08 miles by left-hand trail.
Meadow, head of west fork Relief Creek.	3.09	16.70	....	On divide between Stanislaus and Tuolumne drainage.
Near junction east and west forks	3.20	19.90	7,892	Trail crosses west fork.
Meadow on east fork Relief Creek	4.53	24.43	8,816	Wood, water, and grass.
Divide between east fork and Summit Valley.	1.70	26.13	9,617	Divide between Stanislaus and Tuolumne.
Divide between Summit Valley and fork west Walker River.	2.81	28.94	9,805	
Foot of lake	8.07	37.01	8,183	Lake about one-half mile long.
Round lakes	3.08	40.09	7,309	Two small lakes.
Head of Leavitt's meadow	1.15	41.24	....	
Leavitt's	1.47	42.71	....	Horse ranch and stage station, Mono road.

ROUTES OF COMMUNICATION, TABLES OF DISTANCES, ETC.

The main routes examined by us in 1878–'79 were the Big Tree road, from Silver Mountain City to Murphy's, the Sonora and Mono road, running from Sonora to Bridgeport, and the Bodie mining district; also the three great wagon-roads connecting the foot-hill towns with the Yosemite Valley, and known, respectively, as the Big Oak Flat, the Coulterville, and the Mariposa roads; also that portion of the new route to the Yosemite from Fresno Flat to Clark's or Big Tree station, on the Mariposa road.

The western portion of this route, between Madera, on the Southern Pacific Railroad, and Fresno Flat, was not examined, as it lay entirely without our area. Tables of distances and altitudes on all these important roads have been compiled to accompany your report of this year.

CONCLUSION.

A great deal of interesting country in and about the Yosemite and High Sierra is not described, because this has been so well done by Professor Whitney and Mr. J. M. Hutchings in their respective guide-books. Thanks are due to the latter gentleman for kindness shown the party while in the Yosemite. I wish also to tender my thanks to Mr. Conway and other proprietors of toll trails in that valley for their courtesy in extending us the free use of their trails while we were obliged to use them in the course of our work.

Respectfully submitted.

M. M. MACOMB,
First Lieutenant Fourth Artillery.

Capt. GEO. M. WHEELER, *in charge.*

APPENDIX G.

REPORT OF LIEUTENANT H. H. LUDLOW, THIRD ARTILLERY, IN CHARGE OF PARTY NO. 3, UTAH SECTION, FIELD SEASON OF 1878.

UNITED STATES ENGINEER OFFICE,
GEOGRAPHICAL SURVEYS WEST OF 100TH MERIDIAN,
Washington, D. C., April 4, 1879.

SIR: I have the honor to report on the operations of party No. 3, Utah section, during the field season of 1878, as follows:

The party known as special triangulation and topographical party consisted of H. H. Ludlow, second lieutenant Third Artillery, executive officer; Francis Klett, topographer and assistant; William L. Bailey, meteorological observer and recorder; John S. Stewart, packer; and M. G. Brenholtz, private Company E, Fourteenth Infantry.

Your instructions were to complete certain triangulation work near Austin, Nev.; and then to proceed to Fresno, Cal., where a base line was to be located, measured, and developed.

The personnel of the party was completed at Ogden, Utah, July 24, 1878. On July 29 the party took train for Battle Mountain, Nev.; thence traveling by pack to Austin.

We reached Battle Mountain about 1 p. m., July 31, and made preparation for a speedy departure.

August 1 found the party under way, and it reached Austin about 5 p. m. on the 5th, having rested Sunday, August 4, at Vaughan's Ranch. A stay of ten days in our camp at Rucker Corral, Austin, Nev., gave opportunity for connecting the astronomical monument with the summit of Mount Prometheus by measuring and developing a short auxilliary base, and for occupying, besides the astronomical monument and the ends of the base, three auxiliary stations; also to replace the base-line monuments in Reese River Valley, and to reoccupy Mount Prometheus, as directed by your letter of instructions. It remained to occupy Geneva, Bunker Hill, Poston, Birchim's, Emigrant, and the bases in Reese River Valley. To do this a trip of fifteen days had been planned and the preparations were nearly ready when a serious accident delayed the party about a week. The camp was situated on the main street of Austin, in the immediate vicinity of frame buildings. It was no more exposed than the majority of the buildings on that street which follows the bed of a dry ravine. It was presumably a safe place to camp, and would, no doubt, have been quite secure in any ordinary storm, protected as it was by a strong stockade fence. But it proved to be just the reverse in one of those sudden deluges of water termed "cloud bursts."

About 4 p. m., August 15, a dark, black-looking cloud came up from the southwest. A light sprinkle soon increased to a heavy shower, accompanied by hail. Soon the water began to run in the middle of the street, and gradually increased to a rushing torrent of about 2 feet mid-depth and 20 feet breadth. Presently the backwater began to come into the yard in which the camp was; but no danger of loss was apprehended as the storm seemed to have subsided. But suddenly, and without warning, a wave about 2 feet higher than the water below it, came down the ravine with a rush. It dashed a wood-pile against the fence corner and tore away a portion, carrying off at the same time nearly the whole outfit of the party. Five days sufficed to make a thorough search for missing articles, some of which were found imbedded in mud over two miles from camp, and to get fairly started repairing the recovered aparejos, preparatory to moving. In the mean while Lieutenant Randolph arrived from Ogden, and brought a complete set of meteorological instruments to replace those carried away. After consultation, it was decided to send Mr. Klett with J. S. Stewart, the packer, to Battle Mountain, there to refit the entire pack outfit, while I, with the rest of the party, should go down the Toyabe Range by wagon to finish the Nevada work. Mr. Klett left Austin August 21, with six mules, taking all the damaged aparejos. He reached Battle Mountain after three days forced marching, and the work of repair went on. The rest of the party started the same day (August 21). On the 22d a severe wind blew the cotton cloth off the base monuments in the Reese River Valley. Fortunately it was promptly reported, and they were repaired the next day.

The party moved (August 25) to Kingston (camp 2) for the occupation of Bunker Hill, which was accomplished on the 26th.

The next camp was in Ophir Cañon in the heart of the deserted town of Toyabe City. One man only lived there, and he only two or three days in the week.

The ascent of a low peak near the summit of the pass (August 28) permitted a view of Mount Poston, about 12 miles distant. I decided to cross to the head of Reese River and attempt Poston from that direction. Starting at 1 p. m. we reached the valley and the nearest ranch about dark. A side trip of two days accomplished the occupation of Poston.

August 31, camp was moved to the mouth of Underdown Cañon (camp 5), where September 1 and 2 were lost from unfavorable weather, the ascent of Birchim's being made on the 3d; after which the party returned to Austin, occupying *en route* Emigrant and the ends of the base with as little delay as possible.

One day at Austin sufficed to replace lost mule-shoes and to collect all property left there. Aparejos had been sent down by Mr. Klett, and on September 9 the party started for Battle Mountain, which was reached at 8 p. m. September 11.

The 12th and 13th witnessed an examination of the repaired outfit. All surplus stores were boxed and shipped to Ogden. Whatever was to go with the party was likewise prepared for transportation by rail, and at 7 a. m., September 14, the party started for California.

On reaching Fresno six days were there consumed in selecting a base line, in making and putting up monuments at ends of base, in gathering information, and in arranging stores for shipment.

The base monuments were in shape triangular pyramids, about 30 feet high, the upper 22 feet being covered with white cotton cloth. The sides of the base were about 15 feet, the greatest width of cloth about 11 feet. A space of 4 feet in width, 9 feet from the top, was left bare, which rendered the monuments more easily recognizable by the appearance of the dark line across each. The posts were set 3 feet in the ground. The base line was located some 5 miles east of Fresno, because of a very thick haze, which obscured not only the distant mountains, but even the nearest foot-hills, the latter being visible during my stay of six days only one day.

Leaving Fresno September 27, the party traveled by the ordinary wagon-road to Centerville, and went into camp on King's River, about 2 miles from the latter place.

Fowler Mountain, a foot-hill about 1,000 feet higher than the river bottom, was occupied, and an attempt was made September 30 on Squaw Valley Mountain, but it was found to be heavily wooded, and, after camping near it, September 29 the party moved back to King's River, making camp about 10 miles higher up than before. Here was occupied one of the highest and sharpest of the near foot-hills, called on the Whitney map Tohoetumne, but misnamed Hazleton on the record I left there. It is at the point where King's River emerges from the foot-hills.

The next camp was at Toll House, which was reached by traveling along the lower foot-hills until the Fresno road was found; thence along it. There is a planing-mill at this point, and nearly all the lumber for Fresno and Centerville comes through this place. Burrows Mountain was occupied in this neighborhood.

The party then moved to Behring's store, some seven miles nearer the high Sierras, in order to procure an Indian guide.

Bald Rock was occupied October 10, and the party moved toward Mount Goddard, following Mr. Dusey's wagon track as far as his cabin on Dinkey Creek, thence taking the sheep trail as indicated by our guide.

The party camped on the evening of October 12 near the base of Lookout Mountain, which was occupied for observation the next day. An incomplete sketch was made and a few angles taken, but all points which had been occupied were hidden by the clouds below but near us. This was the highest point occupied in California by the party, the aneroid indicating 10,000 feet above the sea.

It was planned to occupy a point called Woodchuck Peak, October 14, but this was rendered impossible by a snow-storm; and the party was started back, traveling all day in the storm, and reaching Mr. Dusey's at dark. The greatest depth of snow on even ground was 8 inches. The rigging and aparejos were so soaked that the ropes were unmanageable, and a day was taken to get into traveling order.

Burrows, Hazleton (Tohoetumne), and Fowler were occupied on the return trip, and in addition, Morrow and Squaw Valley were taken among the foot-hills, all of which occupied the party until November 1.

The party being south of King's River, traveled through Ash Spring toward Mount Silliman. A point was occupied November 7 and 8 supposed to be the Bald Mountain on Whitney's map, but it does not correspond. Here the lateness and inclemency of the season caused me to stop work in the mountains. Returning to the base line, "Stokes Mountain," a foot-hill on the county line, was occupied November 11, and the party camped at North Base November 13.

The stores at Fresno went to camp November 16. On the 17th the preliminary measurement of the base line began. The line was ranged out by stakes, every hundred feet accurately aligned. It was November 22 when this had been accomplished. Then followed the measurement proper.

Comparisons were made before going to work and on our return from the line with the standard rods of the coast survey, which rods are 5 feet long at known temperatures marked upon the rods. Two of these had been furnished the party.

A platform about 52 feet long and 1 foot wide was erected. Two steel knife-edges were prepared and screwed on this platform at an approximate distance of 50 feet, the edges being at such a height that the exposed ends of the coast survey rods would just pass over them without touching. The rods were applied along a straight line drawn on the platform. The end of the first rod was carefully sighted even with a knife-edge. The second rod was then applied along the line, and contact carefully made with the one already in position. The first rod was carefully removed and placed in like manner beyond the second and so on, until on the fifth application of the second rod its exposed end projected slightly beyond the second knife-edge. A square wooden block placed on the platform was moved into contact with the projecting end of the rod, which was then removed and the distance from the knife-edge to the block was measured by a 3-inch steel ruler subdivided into hundredths of an inch. The sighting in of the first rod and the reading of the distance to the block were both performed by the same person. The temperature was then read and recorded, together with the measured difference. This operation was then repeated, Mr. Klett exchanging places with me and making the adjustment and the reading the second time. This was likewise recorded, with the temperature. The results were then compared, and if differing more than .03 inch, both operations were repeated.

Having thus obtained the data for the accurate determination of the distance between the knife-edges, the steel tape was stretched. Mr. Klett held the rear end of the tape with the notch at the first knife-edge. An assistant stretched the tape at the forward end until the spring was properly extended, while I, as soon as notified of the adjustment of the rear end, superintended the stretching and measured the difference. This was recorded with the temperature and the operation repeated, Mr. Klett and myself changing places. As soon as his reading had been recorded with its temperature the two were compared and if they showed unreasonable discrepancy, both were repeated. In these comparisons and in the measurement, no change was made in the compensating apparatus, it being set at 60° F.

Before commencing the measurement two iron pins were centered under the monuments. Three wooden stools were made about 3 feet high with soft wood tops, end grain, 4 inches square. From the center of each a plumb-bob hung for centering them on the line, and on their tops a pencil line was drawn to be placed parallel to the line to be measured. A wire was stretched in lengths of 600 feet along the stakes already in line under the immediate supervision of Mr. Klett and myself. The first stool was carefully centered over the starting pin and an ordinary pin driven in its top directly over the iron pin. The tape was roughly stretched to give the approximate distance; the second stool was placed accurately over the wire by means of its plumb-bob and the line on its top brought as nearly as practicable in the same vertical plane with the wire. The tape was then carefully stretched. Mr. Klett adjusted the rear end at its notch; Mr. Bailey carried the forward end; and when properly stretched, I drove an ordinary pin in the forward notch along the pencil line on the stool. The tape was then brought forward, the third stool placed in position, and the measurement continued by bringing up the first stool. I placed all the stools and drove all the pins on the direct measurement.

On the reverse measurement Mr. Klett and I exchanged duties. I took his place the first day, after which the adjustment of the rear end was intrusted to Mr. Bailey, while I held myself in readiness to occupy north base, which was accomplished December 5. The base was leveled December 7 and 8, the distance between rod stations being varied according to the nature of the ground.

South base was partially occupied December 6, and completed December 8, while Messrs. Klett and Bailey were at work with the level.

The astronomical monument was occupied December 9, after the mules had been shipped to Sacramento, Cal., in charge of Stewart and Brenholtz.

I left Fresno December 9 by the night train and arrived in Sacramento December 10, according to instructions, and the labors of the party ended.

The following are some of the results of the season's labors:

Main bases measured	1
Auxiliary bases measured	1
Triangulation stations occupied	18
Sights taken	1,624
Miles marched	682
Camps made	41
Cistern-barometer stations	47

In conclusion, let me thank the members of the party for their hearty co-operation. Mr. Klett was invaluable for his many excellent suggestions, especially with reference to the measurement of the base. Mr. Bailey was most remarkable for his zeal and for his care in performing all duties well.

Respectfully submitted.

H. H. LUDLOW,
Second Lieutenant, Third Artillery.

Lieut. GEORGE M. WHEELER,
Corps of Engineers, in charge.

APPENDIX H.

REPORT OF A SPECIAL ASTRONOMICAL PARTY AT OGDEN, UTAH, SEASON OF 1878, BY T. H. SAFFORD, PH. D., ASSISTANT.

WILLIAMSTOWN, MASS., *May* 7, 1879.

SIR: I have the honor to report my doings at Ogden during the field season of 1878. I left Williamstown on July 12, 1878, for Ogden, via Washington. On July 13 I met

Miles Rock, esq., at Philadelphia, and made arrangements with him for the simultaneous observations to be made by us for the longitudes of stations in New Mexico and Texas. I arrived at Washington July 15, and there made the necessary arrangements with Lieut. S. E. Tillman regarding instruments and other appurtenances of astronomical work.

On July 23 I arrived at Ogden and took charge of the observatory, where I found a transit instrument and chronometers. Observations were made for time on nearly every night for three months, or until October 20. Signals were exchanged on the following dates:

July 25, 26, 27, with Professor Newcomb, U. S. N., at Separation, Wyo.
July 27, 28, 29, with Professor Harkness, U. S. N., at Creston, Wyo.
August 12, 19, 21, 26, 28, with John H. Clark, esq., at Walla Walla, Wyo.
September 5, 17, 20, 21, 22, with Mr. Clark, at The Dalles, Oreg.
October 5, 6, 7, 8, 10, with Mr. Clark, at Fresno, Cal.
September 7, 8, 10, 11, 12, with Miles Rock, esq., at Fort Bliss, Tex.
September 26, 27, 30, October 1, 3, with Mr. Rock, at Fort Bayard, N. Mex.

The telegraphic lines employed were in bad order in the sections beyond the railways, so that for Mr. Rock's stations we were compelled to have recourse, in part, to the longer line via San Francisco rather than to the shorter line via Denver.

The condition of things was such that I invariably observed, when weather permitted, before the time assigned for signals, as I never knew whether the line would be ready for use or not until the telegraph operator, Mr. Henry O. Pratt, came to the observatory at the stipulated time. Mr. Pratt was very skillful and faithful. I was assisted, in copying and various mechanical arrangements while observing, by Sergeant Knight, of the Fourteenth Infantry, and on alternate nights by Mr. H. S. Wallace.

On two nights, October 19 and 20, I observed with Mr. Clark for personal equations. I should also have done this on some of the earlier evenings of my stay in Ogden, in July, but Mr. Clark was not of the opinion that his observation then would be normal.

The time observations on signal nights were completely reduced in the form adopted for this survey, and transferred in that condition to Lieut. B. H. Randolph, A. A. Q. M., of the survey, when I left the field. To this gentleman I am indebted for many favors during the campaign. I left Ogden October 21, and reached home November 1.

I am, sir, very faithfully, yours,

T. H. SAFFORD.

Capt. G. M. WHEELER,
United States Engineers.

APPENDIX I.

REPORT OF A SPECIAL ASTRONOMICAL PARTY OPERATING IN CALIFORNIA, OREGON, AND WASHINGTON TERRITORY, BY JOHN H. CLARK, ASTRONOMICAL ASSISTANT.

NOBLE, ILL., *April* 30, 1879.

SIR: I have the honor to submit herewith the following notes respecting the astronomical stations occupied by me during the field season of 1878, together with certain details respecting the work:

ASTRONOMICAL STATION AT WALLA WALLA, WASHINGTON TERRITORY, 1878.

Geographical position.

The pier, of cemented brick, from which the observations were made for the determination astronomically of this station, is situated in block No. 9, known as Jail Square, 57 feet from the center of Fifth street, and 211 feet in a straight line to a street monument in the center of Main and Fifth street. (See plat herewith.) The location was objectionable on account of dust, smoke, jar, and noise, but was unavoidable. There was no other place where the pier would probably be protected and at the same time afford the necessary telegraphic facilities. In erecting the pier the magnetic needle variation 20½° east was used. The transit, however, showed it to be largely out of the prime vertical. The unreliability of the needle in this instance is due doubtless to the components of the soil, which is here constituted largely of bowlders charged with magnetic iron.

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[illegible] surroundings.

Mountain, and running westward and some 30 miles from the moun- [illegible]. Its population is some 3,000. It is [illegible] and is the objective point for the Pelouse country. By irrigation, the [illegible] not only small grain, but the best of [illegible] corn west of the Mississippi Valley. [illegible]—not only apples, pears, and the like, but [illegible] and both as to extent of squares and or- [illegible] of Mormondom. The streets are [illegible] made a rapid growth, and contribute [illegible] the place. They have been irrigated [illegible] they will eventually root deep enough [illegible].

[illegible] conditions.

[illegible]mination in latitude and longitude of this [illegible] much electrical phenomena and some clouds [illegible] nor had there been any to bless this land of [illegible] were observations August 10, 12, 13, 14, 16, 18, [illegible] and 23 cloudy—a week out of three, yet no rain. [illegible] at the observing tent, waiting for the clouds [illegible] brief duration. The "chinook" is a hot wind [illegible] winter, and is particularly remarkable for the [illegible] snow and frost-locked land.

[illegible] communication.

[illegible] Ogden Observatory by way of Boise City and [illegible] between Walla Walla and Winnemucca was [illegible] having been but recently put in order for military [illegible] of delay and worry. Men had to be kept out con- [illegible] were rotten and gave way daily from one cause or [illegible] never working twelve consecutive hours.

[illegible] of observations.

[illegible] ear: Mr. G. M. Dunn recording and giving other [illegible] meteorological observations. The chronometer for [illegible] the telegraph office, distant some three squares. [illegible] were made to detect and rectify any possible error.

Instruments.

[illegible] instrument is old, much worn, and, if at its best, [illegible] of Walla Walla in latitude work. Chronometer [illegible] very fair rate, despite the necessarily rough usage [illegible] to Roseburg.

[illegible]TION AT THE DALLES, OREGON, 1878.

[illegible]graphical position.

[illegible]mination in The Dalles was on the bluff of the lava [illegible] the Steam Navigation Company's offices and work- [illegible] brick and in a position not likely to be disturbed, [illegible] wantonness. From here one can not only overlook the [illegible] view of the lofty and snow-covered cone, Mount [illegible] ridge just across the Columbia River, Mount Adams [illegible] the northwest corner section 3, township 1 north, [illegible] west, distance 117½ feet; and to the south side of Main [illegible] distance is 81½ feet. (See plat herewith.) The meridian [illegible] the bluff facing the Columbia River by an iron pin [illegible] covered by a conical pile of rocks 6 feet wide and 4 feet high. Southward on a large natural mound (which was once a part of the military reservation of old Fort Dalles) it was indicated in the same way.

Dalles City and surroundings.

The Dalles, or Dalles City, in the language of its incorporation, is situated at the mouth of Mill Creek, a very considerable distance below the main part of the rapids of the Columbia River, from which it takes its name. It is a strangely selected spot for a city, for what is not lava bed is for the most part sand. Once there was a level and fertile valley between the city and the foot of the rapids, but that is now almost entirely covered with sand dunes. The wind that pours up the cañon, that sets in at the mouth of Mill Creek, like water through a funnel is apparently the source of all this sand in and about the city. Despite the forbidding character of the location, Dalles City is a picturesque go-ahead town, having many fine stores and pleasant residences, with their charming fruit gardens.

Meteorological conditions.

It took no less than four weeks to put in this station, from August 29 to September 25. Arrangements for observations were ready the 31st. September 1, however, a violent wind carried everything in the shape of tent and other equipment to the ground, making it necessary to put up a substantial frame work. Observations were made, or it was possible to make them, September 2, 3, 4, 5, 6, 7, 8, and 9, although there was much embarrassment from the wind. From September 10 to 19, inclusive, the atmosphere was so full of smoke, driven from the burning Cascade Mountains, that no observations could be made. A few of the very largest stars could sometimes be faintly seen. During this time the sun was stripped of its power and stood in the heavens as a great blood-red orb; the moon had the same general appearance by night; the wind blowing all the while eastward, and sometimes violently. From the 19th to the 25th it was for most part favorable, if the wind be excepted.

Telegraphic communication.

The Western Union office and that of the Oregon Steam Navigation Company not being connected in Portland, an effort was made at first to get Ogden by way of Walla Walla, Boise City, and Winnemucca. The most patient perseverance for many nights brought success but once in this direction, September 5. The office in Portland having been connected, the rest of the signal exchanges were made by Portland and San Francisco, that circuitous but expeditious route.

Method of observation.

Mode of observation same as at Walla Walla; that is, eye and ear. The chronometer did not have to be taken so far; but the climbing up and down the bluff was anything but a safe or pleasant operation.

Instruments.

Instruments same as at Walla Walla. No. 16 is an old instrument, has been put to much service in many places, but the roughest usage it ever had it received probably from the wind and sand of Dalles City, Oreg.

ASTRONOMICAL STATION AT FRESNO, CAL., OCTOBER, 1878.

Geographical position.

The location of the observatory was on a swell of ground some half mile south of town. Pier was of cemented brick, as the other stations. There was no lava bed here as at The Dalles, or bowlders as at Walla Walla, loaded with magnetic iron to affect the needle, the soil being composed almost entirely of sand. It is seldom or never possible to get such a desirable spot in all respects for an observatory as was here presented. The view was unobstructed in all directions, bounded eastward at a great distance by Mount Whipple, Goddard, and other great mountain masses of the Sierra Nevadas, while westward lay the Coast Range.

Fresno and its surroundings.

Fresno is a town that owes its origin to the Southern Pacific Railroad. It is the capital of the county of that name, which is often designated in California as the county of colonies. The court-house is an expensive and showy building, and stands out in marked contrast with all other improvements, both public and private. At this season of the year there seemed to be no vegetation here—nothing green—except that produced by irrigation.

Meteorological conditions.

Had the pier and tent in readiness for observations by October 1, and it was continuously clear till the 11th, when it rained, as also on the 13th and 14th. There was little or no wind, and no dust to interfere, notwithstanding the sandy soil.

Telegraphic communication.

Ogden was got by way of San Francisco, and, there being no delay in the use of the wires, long exchanges with complete clock error could have been had every night from October 1 to 11 had the conditions of the former place been equally favorable.

Method of observation and instruments.

Same as at other stations.

The elaborate stone pillars sent to Fresno for marking the meridian were placed; the one in the meridian north of the pier, just north of the railroad track, and on a line with the first row of houses facing south; the other about the same distance southward and near a road leading to one of the colonies.

Very respectfully, yours,

JOHN H. CLARK.

Capt. GEO. M. WHEELER, *in Charge.*

APPENDIX J.

REPORT OF A SPECIAL ASTRONOMICAL PARTY OPERATING IN NEW MEXICO AND TEXAS, FIELD SEASON OF 1878, BY MILES ROCK, ASSISTANT.

UNITED STATES ENGINEER OFFICE,
GEOGRAPHICAL SURVEYS WEST OF THE 100TH MERIDIAN,
Washington, D. C., May 1, 1879.

SIR: In compliance with your orders to establish principal astronomical stations at Fort Selden, N. Mex., and Fort Bliss, Tex., I left Washington for the field July 12, 1878. At Philadelphia I met Prof. T. H. Safford and arranged a programme for star observations and the exchange of telegraphic time signals. Mr. Fred. W. Floyd, astronomical assistant and meteorologist of the party, joined me at Harrisburg. Your final instructions for the work awaited me at South Pueblo, Colo., and your telegram, at Santa Fé, N. Mex., authorizing me to delay the journey to observe the solar eclipse of July 29.

Lieutenant Paxton, Fifteenth Infantry, and acting commandant at Fort Marcy, loaned me two signal-service telescopes of about 2 inches aperture and 30 inches focal length. Obtaining some plain circular eye-glasses from a jeweler, I smoked and placed one within the cap of each eye-piece. The telescope supports were screwed into posts planted 10 feet north and south of the astronomical monument of this survey, the position of which, as determined in 1873, is latitude 35° 41′ 19″.29 north, and longitude 105° 56′ 45″,22 west from Greenwich. I obtained a correction for my mean-time chronometer (Negus No. 288) by telegraphic signals from Denver, giving alleged Washington true time. The chronometer was 8 minutes 8 seconds fast of Washington mean time.

The following is the result of the eclipse observations in Washington mean time:

Beginning of the eclipse:

	h.	*m.*	*s*
Rock	4	17	51
Paxton	4	17	53

End of the eclipse:

	h.	*m.*	*s*
Rock	6	33	43
Paxton	6	33	42

Each observer independently noted, near the end of the eclipse, the time of the phase that seemed equal to the phase which was first detected, marking on prepared diagrams the appearances that were timed. In this way a more accurate time for first contact was secured.

The actually-observed times were as follows, in chronometer time (Negus mean-time chronometer 288):

By Rock:

	h.	*m.*	*s.*
Phase A, after first contact	4	26	20
Phase A, before last contact	6	41	30
Last contact	6	41	51

By Paxton:

	h.	*m.*	*s.*
Phase A, after first contact	4	26	34
Phase B, before last contact, equal to Phase A according to his diagram	6	41	17
Phase C, before last contact	6	41	28
Phase D, "gone," last contact	6	41	50

Mr. Floyd had charge of the chronometer, and marked time. He and observer, Sergeant Frost, of the Signal Service, read the meteorological instruments every quarter hour during the eclipse, and every half hour during the remaining time from noon to 7 p. m. I also observed a thermometer exposed to the sun's direct rays with its bulb smoked.

While at Santa Fé, Mr. Floyd took comparative readings of the survey barometers with those of the United States Signal Service.

On July 30, we resumed our journey, and arrived at Fort Selden August 2, and staid two days to select the site and arrange for constructing the monument. However, in consequence of the abandonment of Selden as a military post, you subsequently selected Fort Bayard instead. Mr. Floyd took barometric readings in the hall of the commandant's house during our stay.

August 4 and 5 were spent at Las Cruces and Mesilla in efforts to secure materials and skilled workmen for building astronomical monuments, but without success.

On the morning of August 6 we arrived at El Paso (Franklin), Tex. It is also the present Fort Bliss, the troops being quartered in the village. The two old posts of this name are further down the river, 3 and 3½ miles, respectively, and are in ruins. I located the astronomical monument 25 feet northwest from the center of the public square, as shown by a plan of the town, and measuring from the buildings on the southeast and southwest sides. There is no other public ground, and it seems the only place secure against disturbance by future improvements; but being an open common and a rendezvous for cattle and teams, for its present protection I built a rough stone wall 2 feet high and 10 feet square around it. The mason and brick I could get only from El Paso, Mexico, and the brick had to be specially baked by a tile-maker. As the rainy season was at its height and would not permit observation, I waited until the brick pier was built before mounting the transit.

On August 15 I was ready to exchange signals with Professor Safford, at Ogden, but failed to get him, as the Western Union line was down beyond Santa Fé. Each night following I observed for time whenever clear enough, but failed to get a circuit with Ogden for over three weeks.

On August 19 I sought to get a circuit via San Diego and San Francisco, but no trial was made, as others supposed it useless, the distance being about 2,500 miles.

The weather began to settle about August 24, and then I observed for latitude, whenever clear enough, after trying each evening to get Ogden, and on the nights of August 24, 25, 27, 29, 30, and September 1, 2, and 4, observed 184 pairs of latitude stars.

The failure to get a circuit to Ogden via Santa Fé, Pueblo, Denver, and Cheyenne was due to various causes on different nights, but chiefly to interruptions of the line by storms in the Rio Grande Valley and on the stretch between Santa Fé and Pueblo, which was in very bad condition. Finally, fearing failure altogether in getting the longitude by telegraph, I proceeded to observe transits of the moon and moon-culminating stars on four nights before full moon, and, in order to make a complete set, three nights after the full, though by that time I had succeeded with the telegraph. These observations were made on the nights of September 5, 7, 9, 10, 11, 12, and 13, the moon's limb and about six stars on each night.

On September 6 I again tried to get a circuit via California, and on the evening of the 7th succeeded in exchanging time-signals with Ogden, and again on the nights of September 8 and 10. This line was then interrupted, but I finally obtained a circuit via Santa Fé and Cheyenne on September 11 and 12, which completed the observations at this station. There were observed 198 stars for time, of which 127 on the five nights when time-signals were exchanged.

Hourly readings of the meteorological instruments were taken for four weeks, and only at certain hours during the remaining two weeks of our occupancy of the station.

The north meridian-mark is situated nearly a mile off on the edge of a mesa skirting the base of Franklin Mountains, and 360 feet above the monument in altitude. The situation did not allow a south meridian-mark.

The post quartermaster, Lieut. D. J. Gibbon, Ninth Cavalry, furnished tents, tools, and furniture, and hauled lime, sand, brick, stone, and water, and extended all needed assistance.

On September 17, to carry out your instructions in regard to connecting my monument with the astronomical station of the Mexican Boundary Survey, I called on Señor Ramirez, in El Paso, Mexico, who had been one of the Mexican commissioners to locate the international boundary; he pointed out to me the spot, as he remembered it, for there is no mark of the astronomical station of that survey, near the church, with the bell-tower of which I connected it as near as practicable by pacing. It is 140 feet south and 350 west from the tower.

On September 18 we started for Fort Bayard, by an Army escort wagon, furnished by Lieutenant Gibbon. I could thus carry the instruments along, and have them at hand as soon as wanted at Bayard. We took cistern-barometer readings at all the night stopping places; at Cottonwood Ranch, south of old Fort Fillmore; at Mesilla comparative readings with the signal-service barometer; at Mason's ranch, west of Fort Selden; at the spring at old Fort Cummings; and at Miembres Hot Spring, at the foot of the mound of the spring in front of the dwelling.

We arrived at Fort Bayard on September 23, and the same day I located the site for the monument on the solid gneiss rock on top of a hill just outside the quadrangle of the post, about 400 feet from its western corner, and 34 feet in altitude above the surface of the parade-ground at the flagstaff, and in the evening staked out the meridian.

Next day, the 24th, I took our wagon to Silver City, nine miles west of Bayard, for lime and brick, and on the 25th, with the help of a Mexican mason from Central City and a discharged cavalryman, the observing pier was erected. The same evening I set up the transit and was ready to exchange time signals; but the office of the military telegraph was closed, on account of the absence of the operator on repair duty.

Lieut. James Allen, A. S. O., and superintendent of the Sante Fé division of the military telegraphs, ordered an operator up from Silver City in time for the next evening, September 26, when I obtained a circuit via San Diego and San Francisco, and exchanged time signals with Professor Safford at Ogden, Utah; also, on the nights of September 27, 30, and October 1 and 3. There were observed 144 stars altogether for time determinations, and 110 on the five nights when signals were exchanged. There were 65 time signals received from Ogden, and the same number sent each night here, as well as at Fort Bliss.

For latitude there were observed 190 pairs of stars on the nights of October 4, 6, 7, 8, and 9.

The north meridian mark is distant 580 yards on a hill of the same height as Monument Hill; the south mark 820 yards on a lower rise west of Central City.

The meteorological instruments were read hourly during the whole of our stay. On October 8 I sent Mr. Floyd to Silver City with one of the cistern barometers to take comparative readings with the signal-service barometer.

I examined a ledge of white marble near the Hanover copper mines to see if it would furnish blocks for monument caps and meridian-mark stones, and concluded a contract on October 10 to quarry, cut, and letter the stones for both stations and place those of Bayard into position.

Lieut. D. R. Burnham, Fifteenth Infantry, post quartermaster, hauled sand and water and furnished an observatory tent, tools, and furniture and quarters for Mr. Floyd and myself. On October 10 the instruments were prepared for shipment and the public property turned over to the post quartermaster.

On the 11th we started on our return journey on the bi-weekly buckboard. At old Fort Cummings the same day we fell in with Mr. Nell's section of Lieutenant Birnie's party of this survey and compared barometers.

At Mesilla, on the 12th, we took comparative readings with the signal-service barometer, and again at Santa Fé on the 17th.

On my arrival at Santa Fé, October 16, I received your telegraphic order to proceed to Fort Dodge, Kans., and arrived there on October 20. At the post, five miles from the town, your note was received directing me to select a site, estimate the expense, and obtain all needed information for the subsequent establishment of an astronomical station. All which was done on Monday, the 21st, the site selected being the southwest corner of the court-house yard, which is the only public ground on a high part of the town affording a horizon. The same night I started for Washington.

Very respectfully, your obedient servant,

MILES ROCK, C. E.,
Civilian Assistant, in charge of the party.

Capt. GEORGE M. WHEELER, *in Charge.*

APPENDIX K.

PRELIMINARY REPORT OF A SPECIAL GEOLOGICAL PARTY OPERATING IN COLORADO AND NEW MEXICO, FROM SPANISH PEAKS TO THE SOUTH, FIELD SEASON OF 1878, BY PROFESSOR JOHN J. STEVENSON, ASSISTANT.

UNIVERSITY OF THE CITY OF NEW YORK,
New York, April 10, 1879.

SIR: I have the honor to submit herewith a preliminary report upon the geology of the portions of South Central Colorado and North Central New Mexico examined by me during the field season of 1878.

I may here gratefully acknowledge the uniform courtesy shown me by the officers at Forts Union and Garland. To the kindly co-operation of these gentlemen is due not a little of the success marking the season.

Very respectfully, yours,

J. J. STEVENSON.

GENERAL PHYSICAL FEATURES OF THE DISTRICT.

The region examined during the season of 1878 includes part of South Central Colorado and of North Central New Mexico. It is embraced between north latitude 37° 20′ and 35° 40′, and longitude 104° 7′ 30″ and 105° 30′ west from Greenwich. It is represented on atlas-sheets 70 A and 70 C, and its area is not far from 8,000 square miles.

The western part of this region is mountainous, as the Sangre de Cristo Range of Southern Colorado enters it and expands into a group of ranges. At the north the mountains break down abruptly toward the east, and are separated by a narrow longitudinal valley from the Raton Mountains, which on the map are colored as coextensive with the Laramie or Lignitic group. Near the extreme north a high, basalt-covered area, marked on atlas-sheet 70 A as the Raton Plateau, extends eastward from the Raton Mountains, and merges into a great volcanic area beyond the limits of the district.

On the south and east the Raton Mountains look upon the Canadian plains, a broad expanse of rolling country, dotted here and there with low mesas or flat-topped hills, and extending southward and eastward far beyond the region examined. The streams flow across this plain-country in rapidly deepening channel-ways, which become great cañons toward the south and southeast.

The mountain area expands southward for, say, 70 miles, but thence it contracts. The eastern or Cimarron Range breaks down southward, and is lost in a great mesa, which will be spoken of in this report as the Ocate mesa, while the next range at the west bends westward, and the low mesa country is carried almost to the western edge of the district before the southern edge has been reached. The change in the conditions is well shown on the map; for at the north the whole of the mountain area falls within the district, and the plains of the Rio Grande are reached on the west side, whereas southward the expanding of the mountain groups carries a great mountain region out beyond the western border, while at the same time the gradual dying out of some of the eastern anticlinals and the curving westward of others throws almost the whole of the mountain area beyond the western edge of the district.

The region under consideration includes parts of three great drainage areas: that of the Purgatory, that of the Canadian, and that of the Rio Grande. The first two are really subdivisions of the great Arkansas area, but as far as concerns the present report they may be considered as wholly independent.

The area of the Purgatory, which occupies the northern part of the district, begins on the west slope of the Culebra Mountains and extends eastward to beyond the limit of the map. It is the seat of extensive agricultural and mining operations. The important city of Trinidad is the commercial center. The area, however, is narrow and lies north from a line passing east and west through the Raton Plateau. The Canadian area is by far the most important, for it includes all that part of the district lying south from the line already indicated and east from the mountain divide. Economically, its northern portion is as important as the Purgatory area, but the developments have not been carried to so great an extent either in agriculture or in coal mining. The area of the Rio Grande lies wholly west from the mountain summit, as far as the work of last season is concerned, but the divide between it and the Canadian bends to the east immediately south from the region examined, so that thence southward the waters from both sides of the mountain ranges are drained into the Rio Grande.

THE DIVIDES.

The divide separating the areas of the Purgatory and Canadian from the area of the Rio Grande may be best considered as a unit, as indeed it is, separating as it does the

Rio Grande area from that of the Arkansas, of which, as already stated, the areas of the Canadian and Purgatory are but insignificant divisions.

Beginning at the northern limit of the district, we find this divide, there known as the Culebra Range, to be but a continuation of the Sangre de Cristo Range, to which sufficient reference has been made in my previous report. The divide coincides with the summit of the range for a distance of, say, 20 miles, when it bends eastward, or rather is shifted east, a few miles. The southerly course is resumed and retained to the head of Comanche Creek, where it bends westward. It now coincides again with the summit of the main mountain range and so continues to the most southern point reached during the season. The divide is the same with the summit of the mountain ridges marked on the map as the Mora and the Las Vegas.

The passes over the divide are not numerous, and few of them show gentle approaches. The first, beginning at the north, is Costilla Pass, leading from Vermejo Creek, a tributary to the Canadian, to Costilla Creek, a tributary to the Rio Grande. The approach from the west is very gradual, and the summit of the pass is a broad, open, and somewhat rolling plain; but the approach from the east is abrupt, though the difficult grade was easily overcome by making the road serpentine. This pass is but 10,147 feet high at the summit, and is said to remain open during nearly the whole year. But it is little used now, for, although the summit is not likely to remain closed, the approach on the west side is liable to be badly blocked with snow in some narrow defiles. Moreno Pass leads from the head of Comanche Creek, a tributary to Costilla, to the head of Moreno Creek, a fork of Cimarron Creek, which enters the Canadian. This is a low, gentle pass, with easy approaches on each side, but liable to be choked with snow at an early date. It is somewhat uncertain, as the ground is marshy for some distance on each side of the summit. The pass is not thought to be a good one, as it is more apt to close quickly during snow storms than are some of those which are higher and more abrupt.

Red River Pass, leading from the west fork of Moreno Creek to the head of Colorado Creek, was much used while the Moreno mining district was prosperous. An excellent wagon-road was constructed, but since the decay of mining interests the road has been little used and it is in a dilapidated condition. The approach from the east is comparatively gentle, but the grade on the west side is extremely abrupt, difficult indeed for loaded animals. Unless the grade were very materially better in earlier days one can hardly conceive how wagons could have been taken over it. The grade for one mile is nearly ten degrees.

Taos Pass leads from Moreno Valley to the head of Ferdinand Creek and is crossed by the stage-road to Taos. The approach on each side is a comparatively gentle grade until within half a mile of the summit, but thence the grade is very difficult. The pass is 9,095 feet high and is kept open during the winter. Like that of the Red River Pass, the summit of this is exposed, and there is little opportunity for snow to accumulate during the driving storms which prevail. Much freighting is done over this important pass.

A wagon-road, crossing the Mora range from Black Lake on Coyote Creek to a fork of Frijolé Creek, was constructed many years ago for government use; but it followed no pass, and the grade was so bad that when no longer needed by the government teamsters the road was abandoned.

The Las Vegas Mountains present a regular crestline towards the Mora River, a tributary of the Canadian, and two roads cross from Mora Creek to the streams forming Junta Creek, tributary to the Rio Grande. The northern road winds up the mountain side with a painful grade lasting for nearly three miles, but over the summit, on the waters of Junta Creek, the grade is not so difficult. The approaches on both sides are easier along the other road. Both roads are said to remain freely open during the whole winter. No other passes exist along this divide within the district, the distance included being not far from 140 miles. A few trails have been used by the Indians, but, for the most part, these are hardly practicable for loaded animals. One such trail passes from the south fork of the Purgatory to the north fork of Culebra Creek; another, from the Moreno Valley to Lucero Creek, and another from the head of Mora Creek to a fork of Frijolé Creek. These are very obscure, and are badly obstructed with fallen timber, so interlaced that progress is almost impossible.

The divide between the Purgatory and the Canadian begins on the west slope of the Culebra Range, and follows a tortuous course through the Laramie area to the Raton Plateau, and thence to beyond the district at the east. The passes are numerous and for the most part unpleasantly abrupt near their summits.

A gentle pass leads from the Purgatory to the Vermejo in the narrow valley at the base of the range. It is crossed by a good wagon-road and is 9,176 feet high at the summit. A good pass leads from Long's Cañon, tributary to the Purgatory, to the head of the Upper Canadian, and thence to Vermejo Creek. It is followed by a wagon-road, leading from Trinidad to Elizabethtown in the Moreno Valley. Two passes lead from Dillon's Cañon, tributary to the Canadian, to the waters of the Purgatory; the one crossing to Long's Cañon, and the other to Chicken Creek, which empties into Raton Creek. The latter is said to be an excellent pass. The former has gentle approaches on the Canadian side, but for two miles from the summit, on the other slope, it is painfully steep. Raton Pass leads from Willow Creek to Raton Creek, and for many years it has been the most important of the passes over this divide, for the Santa Fé stage and freight road crosses by it. The road is excellent and the grades are good, except near the summit on the Raton side, where, for more than half a mile, the grade is steep, and the pass is hardly available during muddy weather. The soft shales readily break down into mud, and in long-continued wet weather the road seems to become almost bottomless. This pass has been used by the Atchison, Topeka and Santa Fé Railroad, as the distance through the hill, near the summit, is insignificant and the abrupt grades are avoided by a short tunnel.

Manco Burro Pass leads from the head of Chico Rico Creek, a tributary to the Canadian, to the head of San Isidro Creek, flowing to the Purgatory. It is approached from the north or Purgatory side by two roads, one skirting the wall of the Mesa and approaching the pass by comparatively easy grades, the other following up San Isidro Creek. Either of these is available for pack animals and the former is easy for wagons. The roads come together at the foot of the direct ascent to the summit, which is of not so good grade. Still, it is not much more difficult for wagons than the corresponding portion of Raton Pass, on the north side. The approach on the southern or Canadian side is not easy, but it is passable for wagons.

The subordinate divides will be described in the final report on this region.

THE STREAMS.

A few more notes respecting the streams may not be out of place here, as the map will not accompany this preliminary report.

The Upper Purgatory River is formed by the union of several branches within the the Laramie area at not far from the base of the Culebra Range, and flows irregularly eastward to beyond the limits of the district. The several streams forming its forks flow through deep, though short, gorges and unite for the most part within the narrow longitudinal valley at the base of the range. Below the junction of the forks the river flows through the Laramie area in a broad cañon with walls of varying abruptness, which seem to gain somewhat in altitude toward the plains. Long tributary cañons enter that of the main stream from both sides, all of them heading on the Laramie Plateau, which is known as the Raton Mountains.

The Canadian River is formed by the union of the two streams, both having their source in the Laramie area, the one formed by petty creeks rising under Manco Burro and Raton passes, the other rising at the top of the plateau farther west. These unite in the Canadian plains, and thence the river flows southeastwardly to beyond our limits. Its channel-way deepens rapidly and, at, say, 70 miles south from the northern edge of the district it enters a cañon which, where last seen during the season, is 1,090 feet deep. This stream receives many important tributaries from the west, of which Vermejo and Cimarron Creeks have their sources in the mountains and drain a great part of the Laramie area. Ocate Creek drains much of the Ocate mesa, while Coyote, Mora, Cebolla, and Sapello creeks, draining the whole of the mountainous region at the south, unite to form the Mora River, which enters the Canadian near the southeast corner of the district. This large river flows in a dismal cañon similar to that of the Canadian.

THE ANTICLINALS.

The anticlinals of the region fall naturally under three series, thus:

THE CULEBRA AXIS AND ITS SUBDIVISIONS—THE CIMARRON AXIS, AND THE SUBORDINATE AXES OF THE RATON MOUNTAINS OR AREA OF THE LARAMIE GROUP.

The Culebra axis enters the district at the north and seems to be the continuation of the Sangre de Christo Range, though this statement may not be made positively, for I had no opportunity to determine its accuracy. The axis is marked by the Culebra Range, and, so far as can be ascertained, remains simple until a short distance south from Costilla Creek, the line between Colorado and New Mexico, where a fault begins, which apparently marks the origin of the strong Mora anticlinal. The western part of the axis beyond the fault evidently ends at a little way north from Ferdinand Creek, or not far south from Taos Peak, and the new axes are found west from the Mora anticlinal. These I have designated as the Santa Fé and the United States axes, the names being taken from the ranges which show the course of the anticlinals.

Little information was obtained respecting the Santa Fé and United States axes, as they lie altogether beyond the western limit of the district, and were reached only incidentally during a detour made to secure information concerning the west slope of the Mora axis. They remain to be examined during a coming season. The synclinal between the Mora and the Santa Fé axis contains only rocks of the Carboniferous age, and no rocks of later age are involved in the axes themselves. The age of the rocks between the Santa Fé and the United States axis was not fully determined, but it seems to be only Carboniferous in the northern part of the trough, to which alone my examinations were confined.

The Mora anticlinal is a bold axis with a distinct Archean core, and follows an almost north and south course to Cebolla Creek, where it bends westward and follows a southwest course to the southern boundary of the region examined. A great fault was found on the west slope of this fold whereby the Archean rocks are exposed southward from Mora Creek to Sapello Creek. A distinct subordinate anticlinal occurs on the western slope, and is apparently the northward continuation of this fault. Carboniferous rocks alone are involved in this axis.

The Coyote synclinal, between the Culebra-Mora axis and the Cimarron axis at the east, presents some extremely complicated stratigraphy, which has not been worked out in detail, though the general structure is now quite clear. It is hoped that after the short season of 1879 I shall be able to present the structure of this interesting synclinal in all needed detail. Unlike the synclinals at the west, this one holds rocks belonging to the Mesozoic, even those of the Laramie Group.

The Cimarron anticlinal appears as an anticlinal first near Ponil Pass, immediately north from the Old Baldy Mountains, but it is easily followed north far beyond the disappearance of anticlinal structure; for the strata on the east slope of the Culebra Range are violently distorted even to the northern limit of the district. The axis increases in height to beyond Cimarron Creek, but thence southward declines until it finally disappears in an upturned wall of Dakota sandstone in the synclinal at the west. Unlike the other axes, this involves the newer rocks, and at Ponil Pass it is crossed by those of the Laramie Group.

The Cimarron axis is scarcely less interesting than the Coyote synclinal, intervening between it and the Mora anticlinal at the west.

THE SUBORDINATE ANTICLINALS.

Several small anticlinals were observed in the Raton Mountains, and one occurs in the southern part of the district, which is crossed by the Canadian River at but a few miles below the head of the cañon. These anticlinals are not parallel to each other, though there is a close relationship existing among all except that lying nearest the mountain range. For the most part these axes are gentle, with dips seldom exceeding two or three degrees. But the Vermejo axis, the most western of all, shows dips ten degrees on each side. It differs from the others in that its course is nearly north and south, while the others have a north-northeast to northeast trend. These minor axes have decided economic importance, for to their influence is due the accessibility of the lignitic rocks over an extensive area. The Raton anticlinal, passing but three or four miles west from the summit of Raton Pass, is as abrupt as the Vermejo, and its slopes are quite as short. It brings up the great *Trinidad coal bed* to the surface.

The minor axes, in the order of their occurrence, are the Vermejo, the La Junta, the Raton, and the Canadian. In addition to these is the peculiar uplift, the Turkey Mountains, in the neighborhood of Fort Union. This seems hardly to be a true anticlinal, but its features have not been ascertained satisfactorily. The dip is in all directions from a central point and its existence is due probably to volcanic action, which was so energetic in its immediate vicinity.

THE ARCHEAN AREA.

This area is continuous on the western side of the district. It enters at the north and forms the axis of the Culebra Range, continues through the Taos and the Mora Ranges, and passes into the Cimarron Range across the northern part of the Coyote synclinal. It is very broad at the north, though the overflows of basalt have covered much of it on the west side of the Culebra and Taos Ranges. In like manner it is concealed greatly in the Cimarron Range and to a slight extent on the east side of the Mora Range. The Santa Fé and the United States anticlinals show Archean rocks, but those areas are separated from the main area and lie wholly outside of the region assigned for examination during 1878.

The rocks within this area show great uniformity in character. In the Culebra Range there is much coarse gneissoid granite, with here and there some gneiss and mica schist. But near Costilla Creek the general condition changes, and there the prevalent rock is dark gneiss, very fine grained and compact, which is not wholly unlike sandstone in its general appearance. With this there occurs also white quartzite in broad bands, which is of frequent occurrence southward in the Coyote synclinal, along Comanche Creek and the north fork of Moreno Creek. No chloritic rocks were seen except on Costilla Creek, where some thin beds of those rocks occur in close relation to a dike of trachyte.

In the Taos Range, exposures were found only on the east side, where coarse gneissoid granite prevails, though here and there one finds a mottled gneiss, with some beautifully waved schists containing silvery mica. A fine-grained, somewhat greasy gneiss, is frequently shown in the Moreno Valley, between the Taos Range and the Cimarron Range. In the Cimarron Range the gneiss is dark, compact, and cleaves like wood. It holds few streaks of quartz, but here and there it shows blotches of gneissoid granite, which is extremely coarse.

The area of Archean rocks becomes very narrow along the Mora anticlinal southward from Taos Pass. The axis of this anticlinal does not coincide with the topographical range designated on the map as the Mora Range, but lies between Mora Creek and Coyote Creek, and passes almost directly through the towns of Mora, Cebolla, and Santo Nino. The exposures under this anticlinal are very distinct. Along the slope facing Coyote Creek the rock is fine-grained, white gneiss, containing silvery mica. But nearer the axis of the fold the character changes, and the prevailing rock is a fine-grained gneiss, so like unaltered sandstone that one examining only hand specimens might well hesitate before positively assigning it a place. But this rock passes gradually into a dark, micaceous schist, or schistose gneiss, and is much contorted. It contains many thin veins of quartz. The character of the rock changes little southward to the farthest point reached during the season. Coarse gneissoid granite, gneiss, and micaceous schists prevail everywhere. The absence of hornblende rocks is a noticeable feature, none having been found anywhere except in the Mora axis, on Ferdinand Creek, at a few miles south from Taos Peak.

Under the Santa Fé axis a fine-grained, compact, and almost white gneiss was observed. It seems to be the only rock representing the Archean age there.

THE CARBONIFEROUS AREAS.

The areas of Carboniferous rocks are somewhat disconnected. The northern area begins with the district and extends southward along the eastern slope of the Culebra Range to near Costilla Peak, where it ends somewhat abruptly.

Within this the succession is, first, a mass of coarse reddish to grayish red sandstones and conglomerates, in all probably 3,000 feet thick; below this are reddish sandstones and shales alternating with limestones and passing into a coarse conglomerate which rests on the Archean. No successive exposures were accessible whereby a detailed section could be obtained. Three beds of limestone were observed, all of which are clearly of Coal Measures age. The lowest of them, resting on the lower conglomerate, contains no species except those which may be regarded as Coal Measures forms.

Near Costilla Peak the Carboniferous rocks run out against the Metamorphic rocks.

The second area is in the Coyote synclinal, which lies between the Cimarron Range and the Mora axis. Carboniferous rocks are not present on the east side of the synclinal at the north, where the Cimarron axis is strong, but they occupy an earlier trough on the west side of the synclinal, where they lie unconformably beneath Dakota rocks. This area, following the east slope of the Mora axis, begins very near the latitude of Elizabethtown and continues southward to the southern limit of the district. It is more than probable that the examinations of a succeeding season may show that it is connected with a third area occupying the synclinal between the Mora and Santa Fé axis.

The conditions within this area are in marked contrast to those observed in the forformer one. The coarse conglomerate, there capping the series, is wanting, the rocks are finer in grain in the upper portion, and the limestones are increased in number and thickness; but the great conglomerate which was observed at the base on the Culebra Range has become thicker and coarser, so that near the northern exposures in this synclinal it holds huge blocks of the Archean rocks. Here, too, it contains a limestone about midway, which, however, is non-fossiliferous.

Still farther south in this synclinal the change is more marked, for the great conglomerate at the base of the series disappears, a siliceous limestone rests directly on the Archean, and limestones are still further increased in number and thickness, so that on Mora, Cebolla, Manuelitos, and Sapello Creeks the lower part of the series is largely made up of thick limestone beds. A change occurs also in the higher beds of the group. Instead of the coarse conglomerates and the reddish sandstone and brownish red sandy shales, which are present on the Culebra Range as well as in the extreme northern portion of the Coyote synclinal, one finds a mass of gray sandstones in thin beds, separated by thinner beds of red shale, with occasional limestones in the latter. This condition begins near the head of Coyote Creek and continues southward as far as the season's work was carried. An insignificant area of Carboniferous was seen in the heart of the Turkey Mountains, where the gray sandstones and red shales are exposed. No limestones were observed, but Dr. Newberry obtained fragments of *stigmaria* from these sandstones, which at once fixes their age.

The third principal area occupies the synclinal between the Mora and Santa Fé axes. Little investigation was made in this synclinal, as it lies almost wholly beyond the western limit of the district. No detailed sections were obtained anywhere, and the examinations, for the most part, were such as could be made during a hasty reconnaissance. The Carboniferous rocks are not reached in the cañon of the Canadian River within the district; and no rocks belonging to this age were seen on the west side of the Culebra Range. Indeed, they seem to be absent from the west side of the mountains northward from Taos Peak.

THE JURA-TRIAS AREAS.

The Jura-Trias rocks are exposed to but a slight extent. The longest continuous exposure is in the Canadian and Mora cañons, where the series underlies the Dakota sandstone and has a thickness, as exposed, of about 250 feet. A thin, blue, slaty limestone, without distinct fossils, is the highest member of the group. Below this are sandstones, gray and olive, with a grayish limestone at the base, resting on red shales mottled with white.

A petty exposure exists in the Turkey Mountains on the east side, where the rocks, as far as seen, resemble those shown in the cañons of the Mora and Canadian.

Within the mountain area exposures of these rocks are very rare. The whole series is evidently absent from the Culebra Range as well as from the northern part of the Coyote synclinal, where the Dakota Group rests directly on the Carboniferous. But these rocks do make their appearance in that synclinal on Coyote Creek below Guadalupita, and the total thickness of the series is not far from 700 feet. In the upper 20 feet some impure limestones occur, but there is none lower down, where only coarse sandstone and shales appear.

But the condition changes farther south within this synclinal, for on Mora Creek the series is represented by fine red shales and fine-grained sandstones, the latter containing rows of quartz pebbles. What the character of the rocks is on the streams farther south was not ascertained.

No Jura-Trias rocks occur on the Mora anticlinal or the Mora side of the Coyote synclinal. They are shown only on the Cimarron side of that synclinal. They are wholly absent from the synclinal between the Mora and Santa Fé anticlinals.

THE DAKOTA AREAS.

The Dakota Group is exposed in two areas; the first on the east slope of the Culebra Range, from Cucharas Pass at the north to Costilla Peak at the south; the second, a continuous though very irregular area underlying the Ocate mesa at the west, and showing a continuous outcrop along Coyote, Mora, and other streams in the Coyote synclinal, and underlying the great Canadian plains southward from the head of the Canadian Cañon. Indeed, the Dakota is the prevailing rock in the southern part of the district, except where basalt overflows have concealed all.

This group is represented only by sandstone in the northern area, where it varies from fine-grained sandstone to moderately coarse conglomerate. Smooth quartz pebbles are numerous in the coarser beds, and thin *films* of quartz give a honeycomb structure to the finer ones. No fossils of any sort were observed here. The thickness is not far from 300 feet.

In the southern area, the conditions are varied. The rock forms the rim of the Canadian Cañon, where it is only sandstone and about 650 feet thick. Sandstone alone was seen on the Canadian plains and in the Long Cañon of the Mora, but on Sapello Creek, where the group is turned up sharply below the village of Sapello, the composition is quite different; for there one finds shales and sandstone with some argillaceous limestone. The shales, however, appear to be wanting at all exposures north from Cebolla Creek, and certainly there are no shales in the Turkey Mountains or on the broad mesa stretching from those mountains to Coyote and Mora Creeks.

No *coal* was observed anywhere within rocks of this series; the whole mass seems to be practically non-fossiliferous, and no remains of plants or animals were found, aside from some indistinct fucoids in thin-bedded sandstones at the very summit of the section.

THE COLORADO AREAS.

The Colorado Group of King and Hayden includes the numbers 2, 3, and 4 of Meek, as published by him in the Memoirs of the *American Academy of Science* in 1856. These groups show some variations, and at times there seems to be much difficulty in separating them; but the Niobrara and Fort Pierre subgroups, Nos. 3 and 4, are thoroughly persistent and independent. Some doubt may exist respecting the propriety of separating the Fort Benton Group, No. 2, from the immediately underlying Dakota. These pass into each other so gradually that it is not always possible to draw a line of separation between them.

The rocks of the Colorado Group are exposed first along the east slope of the Culebra Range from the north limit of the district southward to Costilla Peak. Beyond this southward the series is buried under igneous overflows.

Insignificant patches of this group remain in the northern portion of the Coyote synclinal, but further south the newer portion of the synclinal becomes exceedingly shallow, owing to the decreasing importance of the Cimarron axis, and the Colorado rocks have been almost wholly removed from it.

The Colorado rocks are finely shown on the plains of the Canadian and Purgatory, and they surround the Laramie area, forming part of the bluff overlooking the plains. The higher members of the group fringe the Ocate mesa almost to its southern border. They have been removed by erosion from a large part of the plains lying between the cañons of the Mora and Canadian, but extensive remnants remain in mesas, many of them preserved by the hard cap of basalt.

The members of this group show little variation within the region examined. The *Fort Benton* sub-group, No. 2 of Meek, is rarely exposed in the Culebra area, but it is fairly well shown near the head of the Canadian Cañon, on the eastern edge of the Coyote synclinal at the south, as well as at several localities farther south, beyond the end of the Cimarron anticlinal. At all localities it is represented by a very dark brown, more or less sandy shale, which becomes more sandy toward the base until it passes imperceptibly into the Dakota sandstone below. No fossils were found in it aside from the characterless fucoids, which belong alike to it and to the Dakota.

The *Niobrara* subgroup, No. 3 of Meek, shows comparatively little variation in character. It is represented by bluish, earthy limestone, alternating with variegated shale, which, however, is mostly quite dark. The series evidently becomes thicker as it recedes from the old land area of the mountains, for it is not less than 700 feet on the Canadian plains along the line of Cimarron Creek, whereas it is much less on the side of the Culebra Range. The limestones are richly fossiliferous at almost all localities, and in all respects the rocks bear exact resemblance to those of the same subgroup in Central Colorado.

The *Fort Pierre* sub-Group has a thickness of probably 1,200 feet, but this could not be determined with accuracy, as exposures in the plains occur only along the streams. These, though almost continuous, are not sufficient to show the thickness of the group satisfactorily. The series consists of shales, varying from argillaceous to arenaceous, brown, drab, and gray, to blue and almost black. For 450 feet at the top, the shales are crowded with concretions, calcareous and ferruginous. The former occur higher up than the latter, and are more frequently fossiliferous.

This subgroup is best exposed in and near the bluffs facing the plains on the east side of the Laramie area. It is exposed also on the west side of that area along a narrow valley following the base of the Culebra Range, and extending from Cucharas Pass at the north to Costilla Peak at the south. Through the influence of the Vermejo anticlinal, its shales are brought up within the Laramie area, on Vermejo Creek and on the south fork of the Purgatory River, where they show the same features as on the plains and at the base of the mountains.

The rocks of this subgroup are seldom exposed within the space represented on map 70 C. They crop out under the east edge of the Ocate mesa, under the basalt cap of the Canadian Hills, and some insignificant mesas have been spared between Cebolla and Sapello Creeks.

The Fort Pierre shales pass imperceptibly upward into the Laramie Group, there being no Fox Hills Group in this region, unless that include also the Laramie or Lignitic, which, as seems to me, is by no means improbable. The junction of the Laramie and Colorado Group is well shown along the whole face of the bluffs toward the plains, as well as along the streams issuing upon the plain from the area of the Laramie rocks.

THE LARAMIE AREA.

The Laramie Group is exposed throughout one compact area, co-extensive with the rolling region lying east from the Culebra and Cimarron Ranges, between them and the plains. In the northern part of the district this area is carried eastward to beyond Trinidad by the Raton Plateau, whose basalt cap has preserved the Laramie rocks from erosion, so that they extend as far east as, say, four miles beyond Manco Burro Pass. But the eastward rise of the rocks makes the Laramie section very thin east from the line of Raton Pass. No Laramie exists in the plains north or south from the Raton Plateau, and the final eastern outcrop is at nearly 2,000 feet above those plains immediately north from Manco Burro Pass. The portion of the area falling within the district is not far from 1,800 square miles; the area extends north beyond the district to Cucharas Creek, but tapers in that direction, so that the whole extent is not more than 2,200 square miles.

This area is cut by many cañons, of which those made by the Purgatory River, Vermejo, Cimarron, and Ponil Creeks cross the whole area, while Dillon's Cañon and that of the Upper Canadian, of Crow Creek, and some others expose the whole section of the Laramie Group. Sections were made in nearly all of the cañons opening upon the plains as well as in many minor cañons opening into those through which the larger streams flow. The process of tying together fragmentary sections is far from being simple, for no limestones exist which may be used as horizons, and the sandstones so closely resemble each other that they cannot be used as more than merely local guides. The detailed sections obtained during the season will be given in the final report, though it may be thought best not to encumber that report with any sections except such as give direct information respecting the succession of the beds. These indicate but a small amount of the physical labor performed in securing material for a generalized section of the group. This section is as follows:

Section of Laramie Group.

1.	Sandstones and shales	440′
2.	*Coal bed (Z)*	Blossom.
3.	Sandstone and shale	77′
4.	*Coal bed (Y)*	Blossom.
5.	Sandstone and shale	75′
6.	*Coal bed (X′)*	2′
7.	Shale and sandstone	45′
8.	*Coal bed (X)*	4
9.	Sandstone and shale	26′
10.	*Coal bed (W)*	6′ to 4″
11.	Sandstone and shale	47′ to 70
12.	*Coal bed (V)*	4′ to 10″
13.	Sandstone and shale	30′ to 36
14.	*Canadian coal bed (U)*	6′ to 4″
15.	Sandstone and shale	26′ to 30′
16.	*Coal bed (T)*	6′ to 2′ 6″
17.	Sandstone and shale	13′ to 20′
18.	*Coal bed (S)*	4′ 3″ to 10″
19.	Shale and sandstone	25′
20.	*Coal bed (R′)*	1′ 4″
21.	Shale and sandstone	25′ to 35′
22.	*Caliente coal bed (R)*	16′ to 1
23.	Sandstone and shale	30′ to 36′
24.	*Raton coal bed (Q)*	3′ to 1′
25.	Sandstone and shale	25′
26.	*Coal bed (P)*	2′ 6″ to 1′
27.	Sandstone and shale	40′ to 50′
28.	*Coal bed (O)*	10′
29.	Sandstone and shale	30′
30.	*Coal bed (N)*	2′
31.	Sandstone and shale	33′ to 43′
32.	*Cameron coal bed (M)*	33′ to 4″
33.	Sandstone and shale	22′ to 27′
34.	*Coal bed (L)*	1′ to 8″
35.	Sandstone and shale	64′ to 70′
36.	*Coal bed (K)*	3′
37.	Sandstone and shale	24′
38.	*Coal bed (J′)*	Blossom.
39.	Sandstone and shale	44′ to 52′
40.	*Long's Cañon coal bed (J)*	8″ to 1′
41.	Sandstone and shale	45′ to 63′
42.	*Coal bed (I)*	2′ 6″ to 2″
43.	Sandstone and shale	50′
44.	*Coal bed (H′)*	1′
45.	Sandstone and shale	50′ to 60′
46.	*Cat's Claw Cañon coal bed (H)*	5′ to 2″
47.	Sandstone and shale	90′ to 111′
48.	*Upper Vermejo coal bed (G)*	2′ to 2″
49.	Sandstone and shale	60′ to 120′
50.	*Lower Vermejo coal bed (F)*	9′ to 4″
51.	Shale	12′
52.	*Coal bed (E″)*	1′
53.	Shale and sandstone	15′
54.	*Coal bed (E′)*	6″
55.	Shale and sandstone	25′
56.	*Upper Reilly coal bed (E)*	7′ 8″ to 2′
57.	Sandstone and shale	18′ to 31′
58.	*Lower Reilly coal bed (D)*	6′ to 2″
59.	Sandstone and shale	12′ to 54′
60.	*Willow Creek coal bed (C)*	3′ 6″ to 1′
61.	Sandstone and shale	76′ to 100′
62.	*Trinidad coal bed (B)*	16′ 6″ to 1′
63.	Sandstone and shale	20′ to 45′
64.	*Dillon coal-bed (A)*	16′ 6″ to 1′
65.	Shale	1′ to 10′
66.	Halymenites sandstone	50′ to 80′
67.	Shale and sandstone	76′

e total thickness of this group is not far from 1,800 feet. The intervals between
oal beds vary greatly and the beds themselves are subject to sudden and unsatis-
ry variations both in thickness and character. Some variations in the intervals
be found inexact, as aneroid barometers do not always act with absolute accu-
but the most noteworthy variations occur within short distances and under cir-
tances which render error in identification of the beds almost impossible. Details
cting the several beds will be given in my report in the chapters devoted to local
gy. It is necessary therefore to give in this place only a few notes respecting the
important members of the series.

e *Dillon coal bed* (*A*) is best shown on Dillon's Cañon, a tributary to the Canadian,
e the bed has been worked. At one exposure in this cañon the bed shows—
al, 4″; shale, 20″; carb. shale, 16″; *coal*, 14″ clay, 1″; *coal*, 3′ 4″.
us giving 4′ 6″ of coal in one available bench. At another exposure the same bed
s two benches of coal, but the coal, though greater in quantity, is not so advan-
usly disposed as the other exposure. This bed is thoroughly persistent as a large
though it is not unfrequently worthless and degenerates into carbonaceous shale.

e *Trinidad coal bed* attains its greatest importance in the neighborhood of Trini-
Col., where it is mined by the Denver and Rio Grande Railway Company for
nent and by others for local use. It has been opened near Raton Pass, directly
r the Raton anticlinal, by the Scandinavian Company, for shipment. At Trinidad
ws seven divisions of *coal* and shale or clay, with a total thickness of somewhat
than 19 feet. But the refuse layers thicken rapidly southward, so that, at an
sure, say three miles from Trinidad, the same seven divisions are shown, but the
ness has increased to 54′ 8″, while at the Scandinavian Company's mines the thick-
is 66′ 6″. The important part of the bed is the fifth division, which shows 5′ 5″ of
at the Rio Grande mines, 6′ at the exposure on Raton Creek, and 9′ 6″ at the Scan-
vian Company's mines. The other benches of coal show a similar thickening, and
otal of coal in the several measurements is 7′, 6′ 10″, 10′ 10″, and 19′ 6″, the last
at the mines of the Scandinavian Company.

e coal from this bed is excellent for gas making, and it is shipped for that purpose
e large cities of Colorado. The "slack" is coked near Trinidad in beehive ovens,
the coke finds a ready market in the mining regions of Colorado, where it has dis-
d that from Connellsville, Pa.

the other coal-beds, those lettered D, E, F, J, M, Q, R, and U are locally impor-
but their variations are so great that they need not be discussed here. The vari-
s in gross thickness are due in many cases to thickening of the refuse layers.

e sandstones of the group are usually fine-grained, yellowish gray and massive,
hese, like the coal beds, are liable to great variations, and only those overlying
eds F, G, H, with those at the top and base of the series, can be regarded as alto-
er persistent. Irregular layers of limestone occur in several of the sandstones as
p in the section as the *Long's Cañon coal bed*. In these the rock is blue on fresh
ce, but, being ferruginous, weathers yellow. No animal remains were observed in
igher rocks, aside from indistinct impressions of a *cardium*, apparently the same
the one which occurs in the *Halymenites* sandstone at the base of the group. But
the flaggy layers of the sandstones impressions of leaves are numerous.

e *Halymenites* sandstone is so named because it is characterized by great abund-
of *Halymenites major*, a fossil not found higher up in the series at any but one
ity. The sandstone is gray to yellowish gray, moderately coarse in grain, hold-
ome pockets of conglomerate, and everywhere, except in Dillon's Cañon, showing
numbers of the nodose fucoid, from which I have given the name. It passes
ward into the brownish shales and sandstones, which in turn merge almost im-
ptibly into the shales of the Fort Pierre Group below.

TERTIARY AND QUATERNARY AREAS.

e distinction between the Tertiary and the Quatenary has not been determined
his district, and much work still remains to be done before I can assert what
ld be regarded as Tertiary and what should be classed as Quatenary.

the Canadian plains and on the mesas within the area of the Mora River, one
ently sees a chalky marl immediately underlying the thin recent deposit cover-
he plains. This has a travertin-like structure and, as far as ascertained, contains
sils. It occupies depressions in the Dakota sandstone; at least, it was observed
under such circumstances at the south, but it is present over a so great extent of
try that its existence cannot be due to any merely local causes. A similar tufa-
deposit occurs along the South Platte River as far as Greeley, where it underlies
upeificial deposit as it does between the Mora and the Canadian Rivers. It is
d that during the coming season the real relation of this limestone to the Santa
arls will be ascertained.

urious conglomerate occurs along the west face of the Culebra Range from Cos-
Creek northward to beyond Fort Garland. It begins at the plains and reaches
to the mountain gorges, forming a series of brownish-red foot-hills, rising in the
st to 10,600 feet above tide. These gravels are of comparatively recent origin,

for they rest on basalt which flowed over the region at a very late period in the Tertiary; so that they must date from very near the close of the Tertiary or from the beginning of the Quaternary.

Further south along the range, these gravels or somewhat similar ones were observed far up in the mountains at the head of Ferdinand Creek and along the various forks of Frijole Creek, streams flowing to the Rio Grande through Taos Creek. Along the north fork of Ferdinand Creek the gravels are stratified and are composed wholly of *débris* from volcanic rocks, including even the latest of the basalts. Some of the layers are fine-grained, while others are conglomerate with great pebbles. On the south fork of Ferdinand Creek, as well as on the forks of Frijole Creek and on Junta Creek further south, the *débris* seems to contain only material derived from the Archean and Carboniferous. On both streams the accumulation reaches to more than 9,000 feet above the sea.

By some geologists these gravels have been referred to lake deposits. In several localities there can be no doubt that such was their origin; but in several other localities there seems to be almost equal certainty that they owe their origin to some other agency. This question will be carefully examined during the coming season.

THE ERUPTIVE AREAS.

A large part of the district is covered by rocks of igneous origin, and a collection was made which illustrates fairly well the varieties observed.

A basalt sheet covers the Raton Plateau, and reaches down into the valleys within the plateau, as well as into the plains hundreds of feet below the top of the plateau. This is but part of a great basaltic area, stretching eastward beyond the limits of the district.

The second great area of basalt is on the Ocate mesa. It extends southward from the cañon of Rayado Creek almost to Fort Union. It stretches westward from the Canadian plains to Coyote Creek, whose valley at one time was filled by the flow. Outliers of this area are seen in the Canadian Hills.

A third area is at the southern extremity of the Turkey Mountains, near Fort Union. This is but of limited extent, and includes at present little more than the volcano at the edge of the mountains. But a stream of basalt flowed from this volcano down an arroyo to the cañon of the Mora River, thence along the cañon to its junction with that of the Canadian River, and backed up in the latter cañon for fully three miles.

Much of this basalt issued in the form of massive eruptions. Dikes are numerous in the Raton area, and some were seen west from Raton Pass in the Lignitic area, many of them occurring as sheets intercalated between the strata of the Laramie Group. But not all of the basalt was poured out in this way. Three volcanic cones remain in the Raton area, on the Capulin Vegas, at only six or seven miles beyond the eastern edge of the district. They are known as the "Mountains with Holes in the Top." A volcano existed on the Ocate mesa, whose cone still preserves its form. But in all probability only a small part of the basalt covering the Ocate mesa and filling up most of the old valleys within that space issued from this volcano. It is altogether probable, however, that the Turkey Mountain volcano was the source of most, if not all, of the basalt poured out in that part of the district, for no traces of the rock exist except in direct lines of flow from that crater.

Light colored lavas of earlier date prevail in the mountainous area, though a great basalt overflow covers much of the western slope of Culebra Range, and reaches across the Rio Grande Valley. The western slope of the Taos Range, as far as could be ascertained during a hasty examination at the close of the season, is covered by eruptive rocks, basalts, trachytes, and rhyolytes; but no detailed examinations were made there.

Enormous dikes of trachyte were seen on Costilla, Comanche, and Moreno Creeks. Patches of the same rock were observed on the east slope of the Culebra Range near the head of Vermejo Creek, and a small patch within the Laramie area stretches from the south fork of the Purgatory River to Vermejo Creek. But the great body of trachytic rocks centers in the Old Baldy Mountains at the headwaters of the several streams forming Cimarron Creek. Two great dikes are shown in the upper cañon of that creek. The overflow from these forms the mass of Old and Little Baldy and covers the high mountains between Cimarron and Rayado Creeks. Many dikes extend northward from this center into the Laramie area and into the narrow park following the east base of the Culebra Range. Costilla Peak is a fragment of an overflow belonging to this group, as also is Bare Cone, near by.

The study of the rock collections has not been completed.

SURFACE GEOLOGY.

Many important facts have been gathered with reference to the surface geology of the district; but a synopsis of them cannot well be made, and I must defer any statement respecting them until the full discussion can be given.

ECONOMIC GEOLOGY.

As directed by you, I have made careful notes respecting the capabilities of the region for settlement, including under this head the distribution of timber, grazing and farming land. These matters will be discussed in the final report.

No important mines of gold or silver were seen. Fine placer gold mines exist in the Moreno Valley, and quartz mining for gold has been carried on extensively along the east side of Old Baldy. But both the quartz and the placer mines have become unimportant, the former through failure of the ore deposits and the latter through failure of the water supply.

Abandoned quartz mines are reported as occurring on Colorado Creek, but no examinations could be made there, for when the locality was reached, the rocks were deeply buried under snow, and the season's work was practically closed.

APPENDIX K (SUB).

PRELIMINARY REPORT OF A SPECIAL GEOLOGICAL PARTY OPERATING IN COLORADO AND NEW MEXICO, FIELD SEASON OF 1879, BY PROF. JOHN J. STEVENSON, ASSISTANT.

UNIVERSITY, NEW YORK CITY,
August 15, 1879.

SIR: I desire to submit the following supplementary report:

In order that some gaps in the work of 1878 might be filled, a party was prepared for me at Fort Garland, which entered the field on May 20, 1879, and was disbanded on its arrival at Fort Union on June 24. Very material favors were received at Fort Garland, Fort Union, and Santa Fé, whereby the brief season was rendered a profitable one, and many thanks are due to the officers at those posts.

The route followed led from Fort Garland to Fort Union by way of the Red River Pass, from Fort Union to Santa Fé by way of Galisteo, and thence to Fort Union by way of the old Santa Fé trail and Las Vegas.

In accordance with your instructions, the economic interests of the region were carefully studied, and these will be fully discussed in the final report. The mines of the Placer Mountains and of Los Cerillos, both in the vicinity of Galisteo Creek, were visited. The former are now as they were when visited by Dr. Wislizenus thirty years ago, and very little work is done. The water supply is uncertain, and at best is too limited to permit the mines to become of great importance. The latter are still too new and undeveloped to permit one to speak positively respecting their future. At the same time it will not be amiss to say that the developments thus far are comparatively insignificant and by no means such as the newspaper accounts had led me to expect. The indications at the time the region was examined were quite indifferent, and the old Spanish mines were far from being so extensive as the ordinary reports allege.

Detailed examinations were made to ascertain the geology of the Galisteo area, where an unexpectedly complicated structure was discovered; but it is hoped that the result of this investigation will be to remove much of the uncertainty which has prevailed respecting the relations of the groups.

The study of the complicated trough between the Cimarron and Mora axes, designated in the report as the Coyote synclinal, has been completed, and numerous cross-sections have been obtained, which will serve to exhibit its peculiar features. Additional information was procured which will lead to a modification of the views expressed in the report respecting the extent of the Cimarron anticlinal. The general structure of the mountain area has been worked out and the relations of the axes are clear.

The relations of a huge mass of rocks underlying the Colorado shales and consisting of two great sandstone groups separated by a group of shale are somewhat obscure. The lower and the middle portions have been regarded as Triassic or as Jura-Trias by those who have preceded me in the study of this region; but for reasons to be given in the final report it may be best for the present at least to include the whole series in one and to apply to it the name *Dakota*. The group may be divided into the Upper, Middle, and Lower Dakota, and for the present it may be regarded as belonging wholly to the Cretaceous. At the same time this reference to the Cretaceous must be regarded as provisional, for a positive reference is not justifiable in the absence of fossils with definite relations.

Unfortunately time did not permit any examination of the west slope of the Santa Fé Range, and the western limit of Archean there is conjectural.

Very respectfully, yours,

J. J. STEVENSON.

Capt. GEORGE M. WHEELER,
In charge.

APPENDIX L.

ORNITHOLOGICAL REPORT FROM OBSERVATIONS AND COLLECTIONS MADE IN PORTIONS OF CALIFORNIA, NEVADA, AND OREGON, BY ASSISTANT H. W. HENSHAW.

UNITED STATES ENGINEER OFFICE,
GEOGRAPHICAL SURVEYS WEST OF THE 100TH MERIDIAN,
Washington, D. C., April 21, 1879.

SIR: I have the honor to transmit the following report upon the ornithology of the regions visited by me during the field seasons of 1877 and 1878.

Very respectfully, your obedient servant,

H. W. HENSHAW.

Capt. GEORGE M. WHEELER, U. S. A.,
Corps of Engineers, in charge.

The present report includes an enumeration of the birds met with during the field seasons of 1877 and 1878 by the writer, with more or less extended notices of their habits, relative abundance or scarcity, extent of habitat, &c., &c., from original field-notes and observations. To but a limited extent has it been thought advisable to depart from the rule of including only results accruing directly from the expedition, and to indicate briefly general facts respecting the distribution of species elsewhere, as compared with the region under consideration. In the instance of a number of the puzzling forms met with, a careful study has been made of their relations with allied species and the results included in the present connection; but in the main the notes bear directly upon the area included in the examinations of the survey for the time specified.

In 1877, field-work in connection with Party No. 1, California Section, extended from the 12th of May to the 1st of October. The following year and with the same party, the interval between July 18 and October 1 constituted the field season. Unfortunately in the latter year work began at so late date that the much desired opportunity was lost of presenting in the present report a full account of the very considerable number of species inhabiting this region, of whose nesting habits little or nothing is known. The notes therefore that bear upon this part of the birds' histories were obtained during the early portion of but a single season.

The routes followed during the two years amounted practically to a continuous line from Carson, near the western border of Nevada and a little south of the Central Pacific Railroad, to The Dalles, on the Columbia River. A considerable portion of the time was spent in the mountains, but more in the valleys and on the plains that lie at their eastern bases. Thus opportunity was had, so far as the necessities of the topographical parties to which the writer has usually been attached would permit, to make a comparative study of the birds of the several sections entered. Taken in connection with what has hitherto been accomplished in the same region, and especially with the very valuable report of Dr. J. C. Newberry, made in 1855, it is thought that the avifauna of the eastern slope, in its general features, may be considered as pretty well made out. Perhaps a brief glance at the area covered in the present report, in its relations to contiguous regions, may be of interest.

The Sierra Nevada of California, in its entire length, and the Cascade Mountains of Oregon form essentially a continuous chain of peaks, which constitutes the first real obstacle to the extension of animals and plants to the westward that is encountered after the main chain of the Rocky Mountains, the "backbone" of the continent, has been passed. So far, at least, as the extension of birds is concerned, it appears to be an extremely effectual one, and the rocky barrier thus constituted may be taken as limiting with precision the Middle Faunal Province.

Attention has elsewhere* been called to the fact that the influence of the Pacific province is visible in the birds of the eastern slope, and the conclusion drawn from a study of its avian life, that, while by no means a typical portion of that province, it is yet sufficiently dashed by Pacific province forms as to more properly be included in that zoological division rather than with the middle region. The number of species and varieties of birds typically representing the Pacific province that are found along the eastern slope is not very great, since, of course, they are limited to mountain-inhabiting forms that constitute but a small proportion of the aggregate number belonging thereto. On the other hand I know of but four species strictly attributable to the middle region that reach into the mountains of the eastern slope, viz, *Turdus pallasi auduboni*, *Carpodacus cassini*, *Pica melanoleuca hudsonica*, and *Tetrao obscurus*. That the number should be so small seems at first thought strange, when it is remembered that the low elevations just east of the mountains are unmistakably middle province in the character of their avifauna.

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* Annual Report of Geographical Surveys West of the One Hundredth Meridian, 1877, p. 1304 *et seq.*

With reference to the geological structure of the Deschutes Basin and other areas just east of the Sierra and Cascade Ranges, Dr. Newberry affirms their intimate connection with the Rocky Mountain Desert; nor in considering the flora and fauna of these areas does he fail to note many examples that serve to indicate their closer affinity to the Rocky Mountain region than to the Pacific.

In the case of birds the physical obstacles to be surmounted, formed by the high mountain crests, although doubtless not without effect, have probably far less to do with the absolute limitation of species than has the check offered by the conditions of a different climate, with the consequent change in plant and insect life which this implies. The region west of the mountains has a large mean annual rainfall, the effect of which upon plant and animal life is further maintained during the dry season by the accession of moisture from the ocean; but the moisture-laden winds are finally robbed as they pass eastward over the summits of the mountains, and they reach the distant interior dry and without life-giving power. As a consequence, and in connection with its volcanic character, the interior plateau country, almost rainless during the summer, is, for the most part, dry and barren in the extreme. The oases, in fact, in this general desert are limited to the areas which, through geological disturbances, have been uplifted to a sufficient height to intercept cloud moisture; and, in addition, the banks of the streams, which afford restricted ground for the growth of vegetation, and through it a home for animal life. With the above well-defined differences of climate, it is not surprising that a corresponding change in the flora and fauna of the two regions is observable.

Although, as stated, the Sierra and Cascade Ranges present in the main a continuous chain, its continuity is interrupted in several places, the Columbia, the Klamath, and the Pitt Rivers breaking through its wall in their progress to the Pacific. Nevertheless, the presence of the natural passes thus afforded does not appear to have a marked effect upon the distribution of birds and mammals, if, indeed, it is to be detected at all. The narrowness of their cañons, flanked as they are in the case of the Columbia by extremely dense coniferous woods, and of the others by an inhospitable desert-like country, would probably have an effect in preventing the passage of species back and forth, were there no other existing cause. But, as remarked before, probably the main obstacle is to be found in the different climates of the two regions. Those species habituated to the warmer, more equable, and moist climate of the Pacific side, and to a country covered with profuse vegetation, would naturally be repelled by the harsher climate and dry, desolate country to the eastward; while such as are inured to the latter conditions would find the former equally unattractive. As further evidence that it is chiefly the climate and the conditions resulting therefrom that limit the range of birds, and not the mere physical barriers offered by mountain chains, it may be remarked that by no means the same amount of difference is to be observed between the birds of the regions that lie contiguous to the eastern and western slopes of the Rocky Mountains that is to be noted here. And we may safely infer that the very marked faunal similarity of the latter sections is largely due to the corresponding similarity of climates, the Rocky Mountains appearing to have little or no effect in limiting the range of birds and mammals.

In a region possessing the forbidding aspect of that to the east of the Sierras, it might be inferred that the sum total of bird life would be rather small. In general, this is true; but along the streams there is usually to be noticed a rather marked concentration of species, while in some favored localities the number also of individuals is great. The mountainous districts, with their heavy growth of conifers and deciduous shrubs, as well as their profusion of annual plants, which up to a certain limit accompany the increased amount of rainfall, form the home of numerous species not found elsewhere. In fact, the more favorable localities in the mountains form the best collecting grounds for the naturalist.

A somewhat special type of country was entered during the past season in the Deschutes River region, the general watershed of which stream has elsewhere been termed the "Deschutes Basin." As it is peculiar in some of its aspects, this region merits brief mention. With a general elevation of about 4,000 feet above sea-level, much of this area is covered by a uniform growth of the yellow pine (*Pinus ponderosa*), which appears to thrive wonderfully well in the light soil of pulverized pumice. From the fact that the water supply is extremely limited and occurs for the most part only as small springs or in water-holes, very few shrubs and plants are able to maintain existence, and a hardy kind of grass alone covers the soil with a scanty growth. So far as birds are concerned, it would be difficult to realize a more complete type of desert than is here presented. For days in succession, I have ridden through these forests, the mules each step sinking above the fetlock in the treacherous dust, which, rising in clouds, marked the route of the party as by a column of smoke, scarcely seeing or hearing a bird. The rare note of a woodpecker or nuthatch, or the chirpings of a few venturesome snowbirds, alone broke the silence of the woods. Even along the banks of the Deschutes there was noticeable at the time of my visit, in September, a remarkable poverty of birds. This I attributed, in the lack of other apparent causes, to the fact that the shrubbery of its banks consisted only of willows, while a heavy growth of coarse grass replaced the bright flowers and varied vegetation of higher altitudes.

Notable as are these forest deserts for absence of bird-life, they yet form the home for thousands of mule-deer and antelope. The former, although generally dispersed, center in greater numbers in certain spots, which are regulated probably by their accessibility to water, and not a day passed without many being started by our train.

The mule-deer, as nearly as we could learn, reaches only into the mountains of the eastern slope, and does not pass the summit; a somewhat singular fact in regard to its distribution, since it reaches quite to the coast in the region south of San Francisco. To the west, in Northern California and Oregon, it is replaced by the Pacific black-tailed deer (*C. columbianus*). This animal, while in the main confined to the region west of the mountains, was ascertained to cross the range at a number of points and inhabit the same sections as the *C. macrotis*. This, however, is the exception rather than the rule, the eastern slope, as a rule, appearing to be free from its presence.

Along the Dechutes River we met with the white-tailed deer, the so-called *C. leucurus*. In comparison with the mule-deer it was not numerous, and its range appeared to be confined to the river-bottom and to the forest closely adjacent.

The antelope, typically an animal of the open grassy plains, concentrates more in the "deadenings," which are often of many hundred acres in extent, or live in the sections where the pines dwindle away and are replaced by a growth of cedar. Still, they were not infrequently met with in the pine woods, their haunts here thus furnishing a strong contrast to the usual home of the species further east.

In connection with my work, my grateful thanks are due for the many courtesies and very material assistance rendered by my friend Mr. H. G. Parker, of Carson, Nev. I am also greatly indebted to Maj. J. M. Norvall, at the time of my visit in command of Camp Bidwell, for the generous hospitality received at his hands. During my stay with him every possible aid to my investigations was freely extended. I would also gratefully mention the aid received from my friend Mr. Robert Ridgway, of the Smithsonian Institution, in the shape of facilities extended in connection with the study of specimens, as also for many valuable suggestions.

TURDIDÆ—Thrushes.

TURDUS Linnæus.

T. migratorius propinquus Ridgw. Western Robin.

This variety of the common robin is found throughout this whole region as a summer visitant, and is more or less abundant according to special locality. In Nevada, the bulk of individuals arrive from the south in March, and spend the early spring in the low and sheltered valleys. As summer advances they make their way higher and higher up on the mountain sides, where they inhabit preferably the aspen groves. The species begins to lay in the neighborhood of Carson about the middle of May. A considerable number of pairs rear their first broods here and in other similar low valleys. But as soon as the young are on the wing all withdraw, apparently to the mountains, and by July, when the lowlands are dry and parched, the sight of a robin is extremely unusual.

Robins were fairly numerous in Oregon, along the Columbia River, during the last of October, and a few doubtless winter even at this high latitude.

T. nævius Gm. Varied Thrush; Oregon Thrush.

This fine thrush is chiefly known to us as it occurs during fall and winter at points far south of its summer home. Apparently its breeding range is wholly confined to the regions west of the Cascade, and perhaps the northern Sierra ranges, from a point somewhere about the Columbia River northward. Even in October I saw but a single individual at The Dalles, while a day's march down the Columbia toward the west slope of the Cascades brought me to where the species was very numerous.

From my friend Mr. H. G. Parker I have information of the occurrence of this thrush near Reno, in Western Nevada, just at the base of the Sierras, thus confirming its supposed presence here, as mentioned in a previous report (1877). Very large numbers made their appearance in this neighborhood about February 1, probably from the mountains to the westward, and remained till into March. Doubtless this is not an unusual event in the history of this species, and we may consider its winter habitat as including the main chain of the Sierras on either slope.

The four instances known of the occurrence of the varied thrush along the eastern coast must be looked upon as wholly exceptionable, especially as no cases are on record of its appearance even in the remoter western States to the east of the Sierras.

Habits.—As the result of my own observations I can add but few details respecting e habits of the varied thrush. In the fall it is not a bird of the open, but ap-ars to pass most of the time in the dense evergreen woods, where it obtains om amongst the low shrubbery various kinds of berries, which evidently form its ief fare at this season. Under my observation it bore out its ascribed character being a rather shy and suspicious bird, and it was only upon occasions that I cceeded in pushing my acquaintanceship to close quarters. While making my ay along the innumerable old wood-roads and tangled bridle-paths that intersect e pineries in all directions—relics of the woodchopper and lumberman—unsuspected, frequently came upon small flocks of these thrushes. The alarm-note is a single nd *chuck*, frequently repeated, and is very similar to that of the small olive-backed rushes, but much louder. A very few moments upon such occasions sufficed to e the band dispersed in alarm, and each seeking a safe position towards the tops the tall, thick firs and spruces, in which they invariably took shelter. Altogether ere is much in the habits and notes of the species that is suggestive of the smaller embers of the genus, and it certainly resembles them in more particulars than does e robin. Still its size, its gregarious disposition, and its partiality for berries, nat-ally cause it to be associated in thought with the robin.

I saw many nests in the crotches of the small firs and upon brushy saplings that, nder casual notice, much resembled the usual structure of the robin, but some of hich were probably constructed by the varied thrush. Not recalling to mind at the me how readily identifiable the nest of this species is—constructed without mud—I glected to examine these structures critically. That more or less remain to breed in e dense forests along the Columbia seems in the highest degree probable, and, in fact, was informed by lumbermen that both "robins" remained all summer.

pallasi auduboni (Baird). Audubon's Hermit Thrush:

During the past summer the important fact was ascertained that this form of the rmit thrush, instead of being strictly limited to the Rocky Mountains, as has hith-to been assumed, crosses the basin and breeds along the eastern slope of the Sierras. uring the summer of 1877 I heard, in several of the subalpine valleys of Northeastern lifornia, what were without doubt the Audubon's thrushes, but failed to secure ecimens. Here they were evidently not very numerous; but in the mountains back Camp Bidwell, the succeeding season, the same thrush was heard, and this time was tisfactorily identified by shooting the bird. They were here very abundant, and at is date, July 19, the pine woods were filled by the sweet music of the males.

pallasi guttatus Pall. Dwarf Hermit Thrush.

The dwarf thrush appears to occur along the eastern slope, as it does in the Rocky ountains, only as a migrant, and as such perhaps only in the fall. By the last of gust it was found numerous along the foot-hills of the Cascade Range of Oregon. I consider it very probable that the southern breeding limit of this form will eventu-ly be found to include the mountains of Oregon, upon their western slope; but we ve no facts of observation to fully bear out such a conjecture.

MYIADESTINÆ—Fly-catching Thrushes.

MYIADESTES Swainson.

M. townsendi (Aud.). Townsend's Fly-catching Thrush.

This bird was found by our party to be very abundant in the Deschutes Basin in ptember, where, too, it was reported by Dr. Newberry in 1860. In fact, I have never en the bird congregated in such numbers over so wide an area as here. In fall and win-r it appears to be generally dispersed over much of the country adjoining the eastern ope, where in summer it appears to be almost entirely absent. During the summer 1877 I saw but a single individual in the mountains of Eastern California, although e condition of this individual, a male, indicated that it was mated and breeding, so at it is to be presumed that the multitudes that throng here in fall localize them-lves in some favorable section during the breeding period.

The localities affected by them in Oregon in fall are almost exactly similar to their nge in New Mexico, Utah, &c., a fact which sufficiently establishes their natural edilections. It is as desolate a type of country as one can well imagine, being cov-ed everywhere with volcanic *débris*, which is thrown up in the shape of low hills or attered broadcast over the general expanse as though the unsightly blocks had ined down. Ravines with their rocky ridges scar and seam the country in every rection, while an almost total absence of vegetation, except in the shape of dwarf dars or stunted piñons, renders such a region a desert indeed. Of such a nature is e country to the south and west of Prineville, Oregon, and here a day's march along e road revealed many hundreds of these fly-catching thrushes.

It is a curious fact in the history of this species that, in the fall, when the season of love, which is supposed to directly inspire the music of birds, has long since passed, and most other songsters are either entirely silent or their songs are limited to the first rude practicings of the young males, the Townsend's flycatcher should now—not at rare intervals, but as a regular habit—give utterance to snatches of melody that, though but a fraction of its splendid powers, may yet challenge the utmost efforts at emulation of most other species. And I am by no means sure that such musical rivalry as takes place at this time among the males does not owe its origin, in part at least, to the fading embers of a passion not yet fully spent. At all events, I have often seen, at this season, two males in eager pursuit of a companion—apparently some coy female—that led them an eager chase for five or ten minutes at a time, in a way that could suggest only the ardor of the mating season. The males engaged in such a chase are always full of song, which pours out as brilliant snatches and fragments of their fuller, more perfect symphonies of spring.

OROSCOPTES Baird.

O. montanus (Towns.). Sage-Thrasher.

Nowhere in the wide region inhabited by this thrush is it more abundant than on the sage-covered hills and plains of Western Nevada, just at the base of the mountains which shut off the western extension of the species.

In a climate like that of Nevada, where the transition period from spring to summer is never very well marked, and summer is at hand almost as soon as the snow disappears, there are always to be observed great irregularities in the time of nesting of the birds. This is as true of the smaller as of the larger species. Thus, taking the present bird as an example, the 20th of May appears to be just about the height of its breeding season. Although at this time not a few pairs were feeding full broods, yet the majority of the nests contained fresh eggs, while some dilatory couples had but just brought their homes to completion. There was thus to be noted a difference of fully six weeks between the earliest and latest periods of deposition of the first clutches of eggs.

As the eye passes over the sage plains of the far West it finds a broad, slightly undulatory expanse, covered everywhere with the characteristic sage-brush and presenting to the sight no breaks in its apparently smooth surface. In reality, however, the plains are very far from being level, and it needs but a short walk in any direction to reveal the presence of unsuspected little valleys and ravines, their boundaries traced on either side by more or less abrupt rocky ridges. It is along the crests and sides of just such ridges that the sage-thrasher is most at home, and in the vernal season, at intervals of every few hundred yards, the males may be heard pouring out at all times of day their delightfully melodious strains. In the presence of its humble associates, the Bell's finch and Brewer's sparrow, which alone share its desolate surroundings, our thrush finds no rivalry to stimulate its efforts; but, unmindful of this, it sings on, finding, perhaps, its reward in the satisfaction born of its own powers or the delight its strains carry to the heart of its silent brooding mate. Its song, though not possessed of great variety, is noteworthy for its sweetness and expression.

The nests, of which I have examined very many, vary but little either in composition or situation. Solidity and bulkiness sum up their chief characteristics. The foundation is of sticks and twigs, the thorny character of which enables them to be firmly interlocked, so as to form a strong support capable of resisting all ordinary accidents, and even to defy wind and weather for many successive seasons. I do not think, however, they are ever utilized a second time. The inner or nest proper is made of rootlets, with perhaps a few horse-hairs, which are woven into a circular depressed cup.

Numerous sets of eggs compared together show but little variation, and this chiefly in the amount and method of distribution of the spotting rather than in the colors themselves.

SAXICOLIDÆ—Stone Chats.

SIALIA Swainson.

S. mexicana Sw. Mexican Bluebird; Chestnut-back Bluebird.

This is the common bluebird of the region. During the summer it inhabits not only the low valleys, but, to even a greater extent, the mountains, being there found in the dense pine timber up to about 6,000 feet. As is the usual custom of the Eastern species, the present bird, as indeed also the Arctic, raises two broods during the summer, and the season is far advanced ere family duties cease.

S. arctica Sw. Arctic Bluebird.

The habitat of the present bird is, in general, more northern than that of the preceding. Nevertheless, the two species are not infrequently marked in local lists as inhabiting the same districts at the same season. When such is the case, the present species is usually found at higher altitudes in the mountains, whence it descends in fall and winter to the same neighborhood where the chestnut-back bluebird makes its summer home. Their connection is hence not so intimate as might naturally be inferred.

The statement of a more northerly habitat for the Arctic bluebird is true only in part; since, while it attains higher latitudes and, coincident with this, seeks out higher elevations in the mountains, it yet was found breeding by our parties as far south as Santa Fé, and here, too, entirely outside of the mountains. This probably represents about its southern breeding limit, while, on the other hand, *mexicana* does not reach much farther south.

A nest of *arctica*, probably the second of the season, was found July 31 in a dead pine stub. It contained five eggs, far advanced.

CINCLIDÆ—Water Ouzels.

CINCLUS Swainson.

C. mexicanus Sw. American Dipper.

Common upon many of the streams of the eastern slope, where noted as high up as the Columbia River.

Concerning the habits of this interesting species, I have no new facts to add to the extended notices which have appeared elsewhere, more particularly as they seem to be everywhere about the same. In reading Macgillivray's excellent account of the European dipper and its mode of life, I notice a statement to the effect that the dipper is by no means an adept at walking on land; he says, after denying its alleged absurd habit of walking in the water on the bottom: "Even on land I have never seen it move more than a few steps, which it accomplished by a kind of leaping motion. Its short legs and curved claws are very ill-adapted for running." * * * Such being the case, it would appear as though there is, in this particular, a very marked difference between the European bird and our own; for no one who has made the acquaintance of our dipper in its native haunts would hesitate for a moment to affirm that it is both agile and graceful in its movements on land, if grace be understood to mean an easy and assured manner. Possessed apparently of equal powers for progression under water with its European ally, our species by no means depends wholly, or at times even in great part, upon these for its subsistence; but, on the contrary, may often be seen for an hour at a time wading in the shallows, or running quickly over the wet rocks or along the pebbly shores in search of food, when its activity and nimbleness of movement are very apparent. In fact, its amphibious nature would appear at times to be almost forgotten, or to be called to its aid only for very brief intervals; while, again, it appears on land, only to disappear a moment later in the swiftly moving current.

SYLVIIDÆ—True Warblers.

REGULUS Cuvier.

R. calendula L. Ruby-crowned Kinglet.

A common summer inhabitant of the pineries. Its songs, loud, clear, and harmonious, were heard all day long issuing from the tall, thickly-foliaged firs and spruces, in which, without doubt, the nests were secreted.

CERTHIIDÆ—Creepers.

CERTHIA Linnæus.

C. familiaris L. Brown Creeper.

A common summer inhabitant of the coniferous belt all along the eastern slope.

TROGLODYTIDÆ—Wrens.

SALPINCTES Cabanis.

S. obsoletus Say. Rock Wren.

A common summer visitant throughout this whole region. Its love for rocky fastnesses is well typified in its name. Its nest is often placed beneath the shelter of a rock, or, as I have on several occasions seen it, in some slight recess or natural cavity in a sand-bank; in fact, any hidden nook or natural recess that promises concealment is available for its purpose. A nest found on the 15th of May contained eight eggs, the young in which were just ready to chip the shell. The rock wren is thus among the very first of the small birds to lay. The eggs vary so little as to be easily characteristic of the species; ground-color pure white, with a rather even distribution over the entire surface of minute, roundish, reddish-brown spots.

Troglodytes Vieillot.

T. ædon parkmanni Aud. Western House Wren.

Numerous as a summer resident all along the eastern slope. As a rule, keeps in the timber of the uncivilized districts, and seems rather loth to accept the accommodations offered in the towns, where, however, it is occasionally seen.

T. hyemalis pacificus Bd. Western Winter Wren.

This bird was not met with until the Columbia River was reached; here in October it was found to be very abundant, more so, in fact, than I have ever known the winter wren to be elsewhere. Nearly every brush-heap contained at least one of these sputtering, scolding mites, while not rarely several were heard or seen in the space of a few yards. It was found on both slopes of the Cascades, although it was not nearly so numerous upon the east side of the mountains as upon the west. As fall advances, it finds its way farther south, and reaches on both slopes as low as the latitude of San Francisco. I am inclined to believe that it breeds all through the pine woods of the mountains near the Columbia. It winters here, as also, according to Cooper, in Washington Territory.

Cistothorus Baird.

C. palustris Wils. Long-billed Marsh Wren.

Extremely abundant in all the tule marshes.

PARIDÆ—Titmice.

Lophophanes Kaup.

L. inornatus (Gamb.). Plain Titmouse.

This species is present in Nevada in the foot-hills of the mountains and on the low ranges to the east of the main chain. It was not met with in the Columbia River region, nor even in Northern California.

Parus Linnæus.

P. rufescens Towns. Chestnut-back Chickadee.

According to Dr. Cooper, this species is the most abundant of the family in Washington Territory, where, however, it is probably limited for the most part or entirely to the districts west of the mountains. Such, at least, appears to be the case in Oregon, where the species did not fall under my observation until at the Cascades on the western slope, where I saw a single small flock in October. It is probably a summer resident here, and perhaps even farther south in Northern California. In fall it migrates to below San Francisco, but does not appear upon the eastern side of the chain.

P. montanus Gamb. Mountain Chickadee.

Breeds numerously among the pines. Extremely abundant among the oaks of the eastern slope, near the Columbia River.

Psaltriparus Bonaparte.

P. plumbeus Bd. Plumbeous Titmouse.

This chickadee, which is peculiar to the middle province, extends its range clear to the foot-hills of the Sierras, but does not enter the mountains. Thus, among the barren piñon hills near Carson City, I saw, in July, a flock of twenty or thirty individuals.

SITTIDÆ—Nuthatches.

Sitta Linnæus.

S. canadensis L. Red-bellied Nuthatch.

This species appears so much oftener in the local lists of the Eastern States than of the Western that many ornithologists have come to regard it as a quite typically eastern species. Nevertheless, in the extreme parts of the West, as upon both sides of the Sierras, from the line of the railroad to the Columbia River, and so on to the north, the red-bellied nuthatch is really a common bird, and in much of this area it doubtless breeds. It appears to be the presence of a country suitably timbered to meet its wants—pine-lover as this species pre-eminently is—more than aught else that determines its presence or absence. In addition, its distribution is clearly governed by its preference for a cool climate, such as it finds in the north or in the high Sierra Nevada.

Towards the Columbia River it was observed to become more numerous, and upon the upper Deschutes its numbers, in certain localities, were comparable with those of the pigmy nuthatch.

S. carolinensis aculeata (Cass). Slender-billed Nuthatch.

A numerous and constant resident among the conifers; not so common towards the Columbia River as either of the other species.

S. pygmæa Vig. Pigmy Nuthatch.

The most numerous of the family in the Sierra Nevada and Cascade Mountains, as almost everywhere through the West.

SYLVICOLIDÆ—American Warblers.

HELMINTHOPHAGA Cabanis.

H. celata lutescens Ridgw. Western Orange-crowned Warbler.

Moderately common in summer when inhabiting the mountain slopes, but most numerous during the fall migration.

DENDRŒCA Gray.

D. æstira (Gm.). Yellow Warbler.

Numerous as a summer resident in the shrubbery of the streams, which the species follows up to an elevation among the mountains of at least 8,000 feet. It penetrates beyond the Columbia and into Washington Territory.

D. townsendi Nutt. Townsend's Warbler.

This bird, which I had hoped, though scarcely expected, to find a common resident of the coniferous belt of the Cascades in Oregon, was met with but twice, in September. In each instance the individual was migrating in company with flocks of Audubon's warblers and other birds.

In full plumage the Townsend's warbler is one of the most beautiful of the family, as it has been until a comparative recent period one of the rarest. Since it was found by the expedition of 1874 to be a common migrant in the mountains of Southeastern Arizona, numerous specimens have been received by the Smithsonian Institution from California, notably from near Sacramento, where obtained by Mr, L. Belding. This warbler appears to be only a casual migrant along the line of the eastern slope, and, in three seasons' collecting, the two mentioned above represent all I have seen. On the Pacific side, however, it is comparatively numerous, both in spring and fall. As to its breeding range, I can find no evidence on record that warrants the statement that the species finds a summer home within our territory. Still it would not be surprising were it eventually found to summer in Oregon, in the dense pine-belt to the west of the Cascade Mountains. If such is ascertained to be the case, this, at least, is likely to prove its extreme southern limit. The fact that the statements of its occurrence in the United States have always been accompanied by the term "migrant," affords pretty conclusive proof that as a species it summers in the far north.

Such migrants as are found in the Rocky Mountains in fall, at which season they alone, have been noted, are to be reasonably accounted for as having followed this path from the extreme northern points of that range, where it approaches the Pacific.

D. auduboni (Towns.). Audubon's Warbler.

Common as a summer resident among the conifers at high elevations; most numerous during the migrations, being, in fact, the chief representative numerically of the *Sylvicolidæ* along the eastern slope.

GEOTHLYPIS Cabanis.

G. trichas L. • Maryland Yellow-throat.

By no means uncommon in Western Nevada, in situations similar to those frequented by the species in the East. A nest found at Washoe Lake, Nevada, May 23, contained four eggs far advanced toward hatching.

G. macgillivrayi Bd. Macgillivray's Warbler.

Fairly numerous in summer along the eastern slope. I find no reference to the species in my note-book as occurring farther north than Northern California. As, however, according to Cooper and Suckley, it reaches to Puget Sound along the coast, it is safe to infer that on the eastern slope it passes the Columbia River into Washington Territory.

A nest found July 24 contained four young a few days old.

ICTERIA Vieillot.

I. virens longicauda (Lawr.). Western Yellow-breasted Chat.

A rather common summer visitant about Carson, Nev., but becoming less so to the northward, until, in extreme Northern California, it is quite rare.

MYIODIOCTES Audubon.

M. pusillus (Wils.). Wilson's Black Cap.

As a summer resident of the eastern slope the species appears to be rare; it may, however, be more common at this season towards the Columbia River than farther south.

June 24 I saw a female of this species in an alpine valley of Northern California, at an elevation of about 6,000 feet. Her excitement at my presence convinced me that her nest was near by; but circumstances not favoring a long search, I failed to discover it. In fall the species is comparatively common.

TANAGRIDÆ—Tanagers.

PYRANGA Vieillot.

P. ludoviciana Wils. Crimson-headed Tanager.

A common summer resident of the eastern slope as far to the north at least as the Columbia River, and without doubt reaching into Washington Territory.

HIRUNDINIDÆ—Swallows.

HIRUNDO Linnæus.

H. erythrogastra Bodd. Barn Swallow.

A numerous summer resident of the lowlands.

TACHYCINETA Cabanis.

T. bicolor (V.). White-bellied Swallow.

This is a more or less abundant inhabitant of the eastern slope, according to circumstances. It was not met with farther north than Northern California. Here in the mountains near Camp Bidwell it was numerous enough the last of July, at which time the pairs all had young, as was shown by their frequent visits to woodpeckers' holes in the aspens.

T. thalassina (Sw.). Violet-green Swallow.

This is an extremely abundant summer visitant in certain portions of Eastern California and Western Nevada, as, for instance, at Pyramid Lake. The pyramid-like cliffs which give name to this body of water form the abode of thousands of these beautiful swallows, which resort to the niches and holes in the faces of the rock for nesting sites.

In the mountains, where it is also abundant, it selects for this purpose the deserted holes of woodpeckers, giving everywhere marked preference to those in oaks. It is almost always found in close proximity to water.

A nest found July 1 contained five young and two unfertile eggs.

PETROCHELIDON Cabanis.

P. lunifrons (Say). Cliff Swallow.

By far the most abundant and generally distributed of the family.

COTYLE Boie.

C. riparia. Bank Swallow.

Present in Nevada and Eastern California, but apparently less numerous than the following.

STELGIDOPTERYX Baird.

S. serripennis (Aud.). Rough-winged Swallow.

According to Cooper and Suckley, this swallow occurs as far to the north on the coast as Puget Sound; certainly present along much of the eastern slope, and doubtless extending into Washington Territory along this line.

PROGNE Boie.

P. subis (L.). Purple Martin.

Colonies encountered at numerous localities among the pine woods of the mountains, where they are quite local.

VIREONIDÆ—Greenlets.

VIREO Vieillot.

V. gilvus swainsoni Bd. Western Warbling Vireo.

This vireo was found to be present along the eastern slope as far north as Southern Oregon, and, as I have never seen it more abundant than it was in Northern California, I have no doubt that it reaches to the Columbia along this line, or even into Washington Territory, as it does, according to Cooper and Suckley, along the Pacific side.

Very little can be said of its habits here that would not be a repetition of published accounts of the Eastern warbling vireo. It is merely that bird transferred from its usual surroundings to the wild mountain districts of the west. In the mountains near Camp Bidwell, the locality alluded to above, where the species was so numerous, I found many nests, three or four being often met with during a morning's collecting. They were without exception built upon small aspen trees, from three to five feet above the ground. With a lining of fine grasses, they were composed mainly of long strips of white fibrous bark, festooned externally with spiders' webs, bits of cottony substances from plants, &c. At this date, July 20-30, the eggs were so far advanced as to render their preservation very difficult.

Vireo solitarius cassini Xantus. Cassin's Vireo.

Few birds have given rise to more perplexing doubt and uncertainty respecting their relationships than the Cassin's vireo. Founded by Xantus in 1859, upon a fall specimen from Fort Tejon, its subsequent written history has been full of vicissitudes; for while by some authors it has been accepted as a valid species, by others it has been affiliated with *solitarius* as a variety; or, again, has been rejected altogether, and thrown into the list of synonyms of the latter bird.

From the time I made the acquaintance of this vireo in the southern Rocky Mountains it has had a peculiar interest for me, more especially, perhaps, from the fact that while then, and upon the many subsequent occasions I have met with it, I have had not the slightest difficulty in properly identifying the recently killed specimens or even the live birds; yet, in the closet and upon comparison with other specimens from the West *marked as solitarius*, I have found it extremely difficult to draw a line between the two; in fact, until the present time I have never been able to arrive at any satisfactory conclusion respecting the true rank of *cassini* and its kinship to *solitarius*. I am now fully persuaded, and trust to be able to show, that *cassini* is at the least something more than a special plumage of *solitarius*, which was the opinion expressed by Professor Baird in his Review of North American Birds, when, it is to be remembered, the type-specimen represented all that was known of the supposed species, the absence of material for comparison doubtless having much to do in shaping this view. Since then there have accumulated in the Smithsonian, as the result of the collections of this expedition and from other sources, twelve or more specimens that are either like the original type of *cassini*, or so near it that their identity with it is beyond suspicion. It is perfectly safe to say that, whatever it is, they are.

With little or no difference in size from Eastern *solitarius*, the type—and it is to be remarked that certain of the recently obtained specimens not only share its peculiarities but even exhibit them to a greater degree—offers only differences of coloration. These may be briefly summed up as follows: Typical examples of *cassini* are very much duller than the corresponding plumages of *solitarius*. The head above and on the side, instead of being of a decided blue or bluish ash, presents little or absolutely no contrast to the olive-brown (instead of olive-green) of the dorsum. The lores and orbital ring, instead of being pure white, are of a dull white, strongly inclining to fulvous. The green of the sides is much mixed with or replaced by brown; the under parts generally are of an impure white, the result of a general admixture of brown. In fact, extreme examples of *cassini* are colored so much like *huttoni* that upon a color basis alone it would be difficult to distinguish them.

There are a sufficient number of specimens at hand showing the above characters to prove beyond a doubt that *cassini* is entitled to rank of some kind; in other words, that it is not a mere accidental plumage of *solitarius*. For be it noted, as stated by Professor Baird of the type, that *solitarius* as it is colored in the East never approaches the above. The color peculiarities of *cassini* are to be regarded then as entirely beyond and independent of individual variation. But, to complicate matters, nearly every author who has had occasion to treat of Western birds has noticed specimens, evidently not typical *cassini*, which he has referred with more or less doubt to *solitarius*. Thus, specimens of so-called *solitarius* are before us from Washington Territory, Oregon, California, Nevada, Utah, Wyoming, Arizona, &c. Some of these are certainly very close to *solitarius*, and I have always presumed the occurrence of that species in the West to be a matter that admitted of no doubt. But a recent careful examination of all these specimens shows not one that can fairly be called *typical* of that bird. In such specimens the back is of a varying shade of green; the head is more or less ashy in contrast, while the under parts are of a purer white than is the case with typical *cassini*. It is to be remarked, however, that not only is it scarcely possible to find two of these doubtful specimens that agree with each other, but by means of them a series can be formed that appears to grade directly from the typical *cassini* towards and almost, if not quite, into *solitarius*. The percentage of specimens of which the statement holds good that they are more like *solitarius* than *cassini* is quite small. Nearly all the intermediate specimens are really identifiable with *cassini*; in fact, of twenty-nine specimens in the collection which have been labeled indifferently *cassini* and *solitarius*, I find that twenty are referable to *cassini*, and cannot by any means be identified with *solitarius*. Of the remaining nine, three are so nearly intermediate that they might with about equal propriety be assigned to either, leaving six with a decided leaning toward *solitarius*. It needs, however, but an instant's comparison of these with the ordinary Eastern *solitarius* to show that although closely resembling that species, it would be going too far to say that they are typically the same. In connection with the rest of the series they are clearly intermediate, but on the *solitarius* side of the line.

The testimony of the series as a whole seems to show pretty conclusively that the solitary vireo proper does not occur in the West, and that all specimens which have been so identified are either *cassini* or are intermediate between the two; the latter class, in fact, furnishing the evidence that the two inter-grade, and hence that *cassini* is a variety of *solitarius*.

The only alternative would be to throw *cassini* out entirely and refer all Western specimens to *solitarius*. But, in our judgment, typical specimens of *cassini* are now too numerous and show too decided and constant differences to warrant such a procedure.

The habitat of Cassin's vireo may receive a moment's attention. Its summer home appears to be strictly limited to either slope of the Sierra Nevadas, from Washington Territory to Southern California. I can find no specimens (including under the head of *cassini* all individuals hitherto supposed to be *solitarius*) from the Rocky Mountains in *spring or summer*.[*]

As a migrant in fall the occurrence of the Cassin's vireo in the latter range is not surprising, or no more so than that of several other Sierra Nevadan birds, as *Junco hyemalis*, *Turdus pallasi nanus*, *Dendroica townsendi*, and *occidentalis*, &c.

I have alluded in a foot-note below to a specimen, the coloration of which is intermediate between *solitarius* and *plumbeus*. Such specimens do not appear to be as common as in the instance of the Cassin's vireo, but I have seen too many such to render the relationship of the two former birds at all doubtful in my own mind. With its notable increase of stature, and the laying off of nearly all the bright tints that distinguish *solitarius*, *plumbeus* might well pass for a different species, but for the fact that specimens of unquestionable intermediate character have been repeatedly taken; so that consistency would seem to demand that its near relationship to *solitarius* should be formally as well as tacitly admitted. Although this race possesses an average size considerably in excess of *solitarius*, the latter occasionally leads well up to its smaller individuals. *Turdus pallasi*, with its race *auduboni*, furnishes precisely the same phenomenon of increase of size coincident with a mountain habitat.

Of the two Western varieties of the solitary vireo, *plumbeus* appears to be the best marked. This is not because typical examples of it are any more readily recognizable than of *cassini*, but because intermediate specimens of the former appear to be less common; in other words, *plumbeus* appears to be further advanced in the process of differentiation, and hence to be more constant to its type. Too much stress should not, however, be laid upon this apparent fact, since the locality of specimens of this race appears to be an important factor. Thus, all specimens of the plumbeus vireo that we have seen from the neighborhood of Fort Whipple, Arizona, the region whence described by Dr. Coues, are extremely typical; but from points farther north, as Forts Laramie, Bridger, and thereabouts, nearly all—perhaps all—are to a varying extent intermediate.

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[*] A specimen, No. 11,064 of Nat. Mus. Res., taken at Fort Bridger in May by Drexler, was labeled *solitarius* and so referred to by authors. This I ascertain upon examination to be the plumbeous vireo (*V. solitarius plumbeus*). Its colors are those of *plumbeus*, with the addition of a slight admixture of green, it being in fact intermediate between that form and *solitarius*.

Similarly, the eastern slopes of the Sierras and Cascades appear to furnish, in summer at least, nothing but typical *cassini*, while from the Calaveras Grove California, and other localities on the western side of the mountains, we have both typical and intermediate specimens, both styles breeding. As bearing on the subject, I may recall the fact that many of the shrikes from the same localities are scarcely distinguishable from specimens from Florida (*ludovicianus*).

To sum up, the solitary vireo, like many other birds, appears to be divisible in three distinct races, according as it inhabits the eastern, the middle, or the Pacific provinces. Each has its own restricted summer habitat, where it alone is found. In fall the two Western mingle, to some extent, during the general dispersion attendant upon the fall migration.

The following figures indicate the size of each of the three forms:

Solitarius.—Average of 11 specimens: Wing, 2.92; tail, 2.23; bill, .40; tarsus, .71: largest individual, 3.06, 2.35, .38, .72; smallest individual, 2.80, 2.15, .40, .73.

var. plumbeus.—Average of 17 specimens: Wing, 3.14; tail, 2.40; bill, .43; tarsus, .74: largest individual, 3.22, 2.45, .43, .77; smallest individual, 3.03, 2.25, .43, .74.

var. Cassini.—Average of 28 specimens: Wing, 2.82; tail, 2.23; bill, .41; tarsus, .73: largest individual, 2.93, 2.27, .42, .67; smallest individual, 2.70, 2.01, .43, .73.

LANIIDÆ—Shrikes.

LANIUS Linnæus.

L. ludovicianus excubitorides (Sw.). White-rump Shrike.

Most numerous in summer, when it lives chiefly in the lower foot-hills among the sage-brush. Some appear to remain all winter in the latitude of Carson.

The northern shrike (*C. borealis*) also appears here in fall.

TANAGRIDÆ—Tanagers.

PYRANGA Vieillot.

P. ludoviciana (Wils.). Louisiana Tanager.

A summer visitor of the mountains, as high up at least as the Columbia River.

A nest found June 26, near Susanville, Cal., contained three young and two eggs, the latter just on the verge of hatching. The nest was a loose structure of rootlets, similar to the usual style of the *P. rubra*, and was placed on the extremity of a limb of a cottonwood, about fifteen feet from the ground.

As a rule, our tanagers lay but three eggs, and five must, I think, be a rather unusual complement.

FRINGILLIDÆ—Sparrows, Finches.

LOXIA Brisson.

L. curvirostra americana, Wils.

This crossbill becomes numerous in the mountains and on the foot-hills in fall. It is presumably a resident in Oregon, although I cannot find any direct evidence to this effect.

CARPODACUS Kaup.

C. purpureus californicus (Bd.) Californian Purple Finch.

A single individual of this species was taken at The Dalles on the Columbia in October from a flock of pine finches. This is the first record of its occurrence at any point along the eastern slope, its distribution being to the west of the mountains from as far north as the Straits of De Fuca (Cooper) to below San Francisco.

C. cassini Bd. Cassin's Purple Finch.

An abundant summer inhabitant in the neighborhood of Carson, and, although, perhaps becoming rather less numerous as northern California is reached, the species persists to the Columbia River. This, I believe, gives it a more northern extension than has hitherto been supposed. In summer they are quite local, and crowd into a certain neighborhood of a section to the total disregard of others which, perhaps, appear no less suited to their economy. I found communities of considerable size thus colonized in certain parts of the pine woods about Eagle Lake, California, and elsewhere. In common with others of their kin they are delightful singers, and the burst of melody which greets the ear of the chance passer by as he happens upon one of these musical oases in the generally silent forests is no less pleasing than it is unexpected. Like the common goldfinch (*C. tristis*) the males have the habit of singing in chorus, and it takes very little imagination to construe their efforts into rival contests. Whether they possess such significance to the birds themselves or not, it is certain that each individual appears to sing his loudest and best, as though trying to drown the notes of his neighbor, or, perhaps, too well pleased with his own efforts to care for aught else. The effect, as the medley of delightful strains goes ringing through the leafy arches of the pineries, is pleasing in the extreme.

The nests, of which I have seen many, were all placed on large pines and well out toward the ends of the lower limbs.

By the latter part of June nearly all the pairs were feeding young, and none of the nests that were accessible contained eggs.

C. frontalis (Say). House Finch.

An abundant species wherever found. It was not observed much farther north than Honey Lake, Northern California.

CHRYSOMITRIS Boie.

C. tristis (L.). Common Goldfinch.

A common summer resident at many points. Found on the Columbia River in October.

C. pinus (Wils.). Pine Finch.

This species occurs along the whole eastern slope in fall and winter, and passes the summer in the coniferous belt in much of its extent. In Oregon, from August on, wherever I penetrated the mountains, I was almost sure to run across flocks of these finches, whose twittering notes often betrayed their presence in the tops of the tall pines and spruces when the birds themselves were only visible upon patient scrutiny.

PASSERCULUS Bonaparte.

P. savanna alaudinus Bp. Western Savanna Sparrow.

Numerous in all wet meadowy lands, and as much so in Oregon as farther south.

A nest taken near Washoe Lake, Nev., May 22, contained four fresh eggs. These are rather peculiar both in shape and in markings, although the differences probably represent nothing but individual variation and are not distinctive of this western race. They are of a greenish-white ground color, heavily blotched in a more or less confluent ring at the larger ends with burnt sienna and various shades of lavender. They are short and rounded in shape, measuring $(68 \times 55)^2$, 66×54, 65×53.

P. savanna sandvicensis (Gm.). Sandvich Sparrow.

The preceding form is the type that prevails in summer all along the eastern slope. In fact at only one locality did I detect the presence of the present bird, viz, on Crooked River, Oregon, in September.

A sandy pasture at this point proved favorite ground for the savanna sparrows, and a walk through the weed patches usually resulted in starting up scores. Among the rabble I noticed one day an individual of apparently larger size than the rest, and upon shooting discovered it to be of the present race. Further search resulted in the acquisition of one additional specimen. So far as known *sandvicensis* is a strictly coast form; but its presence here is, after all, by no means remarkable, since in the fall migration a few might readily find their way up the Columbia River and so move south along the eastern slope. As I did not find it elsewhere, I judge it to be rare.

POOECETES Baird.

P. gramineus confinis Bd. Western Grass Finch.

Numerous in the valleys. Noted no farther north than Southern Oregon, but, without doubt, extending into Washington Territory.

CHONDESTES Swainson.

C. grammaca (Say). Lark Sparrow.

This species was lost sight of about one hundred miles north of Carson. It doubtless occurs in the low valleys, quite up into Oregon; in fact, Suckley records a single specimen from The Dalles, on the Columbia.

ZONOTRICHIA Swainson.

Z. albicollis (Gm.). White-throated Sparrow.

Dakota has hitherto been given as forming the western limit of this sparrow. Nevertheless, it seems probable that it is to be added to the list of eastern species that reach the Pacific on the northwest coast and summer at the point where the Rocky Mountains dwindle away and admit of free passage. At all events, the presence of the white-throated sparrow was detected on the Columbia River, about forty miles from The Dalles, and thus beyond the eastern slope, and one of the two individuals seen was captured. I presume that it is by no means scarce here, although as the individuals noticed were seen only an hour or so before camp was broken for the return up the river, no opportunity was had for a satisfactory investigation of the matter.

Z. leucophrys (Forst.). White-crowned Sparrow.

As almost everywhere throughout the West, this sparrow occurs along the eastern slope in great numbers during the migrations. It is also numerous in these mountains in summer, resorting to breed to the willow thickets and aspen groves along the streams.

A nest found in Eastern California, June 20, contained four eggs but slightly advanced. Several found on the 24th held young. The nests were quite typical of the ground-building sparrows, being outwardly composed of weed-stalks with an interior lining of fine grasses and horse hairs, the whole snugly hidden away with a sparrow's cunning beneath a small bush.

The eggs are of a faint bluish green, irregularly and profusely spotted with reddish brown, which is most conspicuous at the larger ends.

Z. gambeli intermedia Ridgw. Ridgway's Sparrow.

Flocks composed of this and the previous bird frequently fall into the path of the collector in this region during spring and fall. The present bird was not found in the mountains as a summer resident, and I believe it goes farther north to breed. Mr. Ridgway, indeed, in his recent report to King,* mentions this bird as nesting in numbers at Donner Lake Pass in the Sierras; but, as I now learn, he believes that his identification was incorrect (circumstances not permitting specimens to be obtained), and that the species thus referred to was, beyond doubt, the *Z. leucophrys*. This agrees fully with my own experience in this region, and leaves us with no record of the breeding of the *var. intermedia* in the Sierras.

I have elsewhere presented facts bearing upon certain differences in the migrations of these two *Zonotrichias*, and have referred to the very extensive overlapping, eastward and westward, of their respective habits, urging that these considerations, coupled with the constant, albeit slight, differences in coloration between the two, were sufficient to warrant the conclusion that *intermedia* was not a race of *leucophrys*. I am more than ever convinced of the truth of this. The *Z. leucophrys* is now known to breed on the northern frontier from the Atlantic to the Rocky mountains, and thence to the summit of the Sierras, and to follow the trend of these ranges far to the southward. Over all this immense region it maintains its characters with perfect consistency, there appearing in fact to be no appreciable differences between specimens taken on the Atlantic and others from its most remote western point. So far, then, as geographical considerations offer any evidence, it is manifestly absurd to consider *intermedia* as the "western" representative of a bird that in its typical condition is found in nearly every portion of the West, and that, too, breeding.

On the other hand, that the relations of *gambeli* and *intermedia* are those of species and variety seems perfectly certain, and the two may be so treated in perfect conformity with well ascertained laws of geographic variation, *gambeli* being the darker coast representative of the pale, more northern (?) interior form *intermedia*.

Z. coronata (Pall.). Golden-crowned Sparrow.

This sparrow occurs along the eastern slope during the fall migration, but by no means in such immense numbers as distinguish its presence to the westward. On the contrary, its numbers are limited to the comparatively few that find their way into the bands of white-crowned and Ridgway's sparrows, and with them perform the journey southward, or winter in favorable localities. Suckley, however, speaks of the Golden-crowned Sparrow as an abundant summer resident about The Dalles.

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*Ornithology of United States Geological Exploration of the Fortieth Parallel, Clarence King, in charge, p. 471.

JUNCO Wagler.

J. oregonus (Towns.). Oregon Snowbird.

This snowbird appears to pass the summer among the mountains, from about the latitude of Carson, Nev., northward, and is the only one of the genus that inhabits the Pacific province.

A nest found June 23 contained young. It was placed on a hillside in a little patch of an evergreen shrub that raised above the earth sufficiently to screen the nest, the top of which was sunk on a level with the ground. This may have been an unusually late brood, for I had taken fully fledged young some few days earlier.

A second nest, found August 2, held three young, several days old.

I subjoin a description of the young in the first or nest plumage, remarking that in this condition the young of all our snowbirds resemble each other very closely, those of several of the forms, in fact, being distinguishable only with great difficulty.

First plumage: Prevailing tint above rufous, the feathers streaked medially with black; wings and tail blackish-brown, each feather edged with rufous. Throat, breast, and sides profusely spotted with black; belly of a fulvous white; sides washed with rufous; first outer tail-feather always, usually the second, sometimes the third, white.

AMPHISPIZA Coues.

A. belli nevadensis (Ridgw.). Artemisia Sparrow.

This sparrow breeds abundantly among the artemisia wherever it grows, and even follows it to a considerable altitude in the mountains, although the sage plains, at their lower levels, appear to be the proper home of the bird. The species occurs less abundantly in Northern California than to the southward.

In the vicinity of Carson, where I found several nests, its eggs are laid about May 15. As nesting sites sage bushes were invariably selected. Dried weed-stalks make up the bulk of the structure, with an interior of the soft, fibrous sage bark, inside which is the lining proper, of sheep's wool, which is readily obtained by the birds almost anywhere in this country.

The eggs vary much in the exact character of their markings, as also, to some extent, in size. With a faint greenish-white background, they are spotted, much less heavily at the smaller than at the larger end, where the markings are often accumulated into a circle, with various shades of brown inclining toward sienna, with lavender, and faint purple. The sienna is often laid on in the shape of scratches or blotches, so densely as to appear almost black. Altogether the appearance of the eggs of this species is peculiar.

Two sets measure as follows: $(79\times58)^2$ 83×58 75×58; $(76\times58)^2$ 77×57 78×57.

SPIZELLA Bonaparte.

S. monticola (Gm.). Tree Sparrow.

A flock of tree sparrows was seen upon the Columbia in October, but, owing to a failure to interest my mule in the matter, no specimens were actually secured.

Dr. Cooper leaves a note to the effect that he saw what he took to be tree sparrows in the Sierras, and Suckley obtained a bird at The Dalles in winter which he identified, per book, as of this species. So the tree sparrow may be presumed to be a fall migrant and winter resident of this region on both slopes of the Sierras; but it is probably less common than farther east.

S. socialis arizonæ Coues. Western Chipping Sparrow.

A common summer inhabitant of the eastern slope. It is found in Washington Territory, west of the mountains, and doubtless to the east, although it was not met with about the Columbia, perhaps owing to the lateness of the season.

S. breweri, Cass. Brewer's Sparrows.

This quaint little sparrow is almost as characteristic an inhabitant of the sage-brush plains as the Bell's finch. Together with the latter bird and an occasional sage thrush this species makes up the usual avian life of these forbidding wastes and, in numbers at least, the Brewer's sparrow is the most conspicuous of the three. Living often far distant from water, and with no hint of the usual attractive surroundings that we come to consider as being necessary to the happiness if not the very existence of bird life, our little sparrow appears to be perfectly contented with its lot and unmistakably expresses himself so in the unobtrusive but pleasant little songs he sends forth at odd times during the entire day.

In what appears to be somewhat exceptional instances, this sparrow varies its habitat to a considerable extent. Thus I have occasionally found the summits of the high peaks to be occupied, together with a few other species, by the Brewer's sparrow. The low brush or "scrub" into which the luxuriant sub-alpine vegetation dwindles, as the higher altitudes on the mountains are reached, seem to offer conditions sufficiently similar to its more usual haunts to meet all requisites. In such spots the Brewer's sparrows were often very numerous, while the presence of young birds sufficiently attested the fact that here was their summer abode.

The nests of this sparrow are very much like the usual structures of the "chippy," but appear to be invariably placed in a low bush. Much variation appears in the shape as well as the markings of the eggs. The latter usually occur as blackish spots and blotches; these are generally few in number, and are mostly at the larger end, leaving the greenish-blue ground unoccupied for its greater part. Some specimens show no traces of black, but the spotting assumes a reddish-brown or neutral tint, often confluent in a ring at the larger end. Other sets have only a faint irregular freckling of the same. The smaller eggs exhibit a more or less decided pyriform shape, while those of larger size vary in the direction of a more elongated oval. The following measurements express these variations in size: $(67\times48)^2$, 68×47; $(63\times48)^2$, $(62\times47)^3$; 69×50, 68×52, 65×50, 69×53.

MELOSPIZA Baird.

A study of the song sparrows of the United States and adjoining regions reveals an extraordinary amount of variation, coinciding more or less closely with definable geographical areas. Others of our species are possessed of a similar wide range, but in no other are exhibited such marked variations of color and such mutations in size as in this.

The song sparrow, although apparently nowhere a permanent resident, in the strict meaning of that term, that is, to the extent of the same individuals remaining in the same place throughout the year, is yet migratory to only a limited degree; and it is probable that the change of locality with the migrations is, in the instance of none of the forms, very marked. It is doubtless to this localization and the resulting constantly-exerted influence of the same circumstances of environment, that we are to attribute the extraordinary tendency in this bird to develop into races and offshoots, according as its range brings it under differing conditions. As Dr. Coues happily phrases it, "Migration holds species true; localization lets them slip." And nowhere is to be found a better illustration of this aphorism than is presented by the song sparrow.

A recent examination of the extremely large collection of song sparrows in the Smithsonian Institution, in connection with the extensive suite gathered by the Expedition, has developed some facts that appear to be of sufficient value and interest to warrant brief mention. Here as elsewhere the variation, through which the forms are indicated, are of two kinds, viz, a variation in size and a variation in coloration; nor is it easy to say in which direction the changes are most pronounced.

The only song sparrow found in eastern United States, and which extends from the coast as far west as Nebraska and Indian Territory, is the *M. melodia*; and of all the forms, except possibly *insignis*, this appears to be the most constant in the maintenance of its peculiarities over its wide habitat. In fact, so far as color goes, the variation appears to be scarcely noticeable; nor is the variation in size very marked. Such as it is, it appears to bear out the general rule of an average increase of size to the northward. This law, it may be remarked here, appears to be equally applicable also to all the other races. The general sameness in the topographical character of the eastern region and the resulting similarity of climate is doubtless the chief cause of the slight departure from type to be observed in *melodia* throughout its range.

The Rocky Mountains as far to the north as Oregon and to the south to our southern border, and the entire region west to the Sierra Nevadas, is occupied by the var. *fallax*. This bird is distinguishable from *melodia* by a generally paler tone of coloration, by a decided increase in size, especially of wing and tail, and by a slightly longer and considerably more slender bill. The intergradation of this form with *melodia* is readily traceable and complete. From the very varied nature of the country occupied by *fallax*, it being broken up by lofty mountain ranges, and the ensuing differences of climate, considerable discrepancies might naturally be expected in specimens of this race from different localities. Such proves to be the case; and, in examining a large series, the attention is often arrested by some slight phase of color which is often so intangible as to practically elude definition, but which occasionally is sufficient to identify all the individuals from some one limited neighborhood. So frequently is this impression received, that it would almost appear as if each locality in the middle region furnished a type of its own, exhibiting the main characters of *fallax*, but differing more or less appreciably. Thus the region of the Gila River affords a style of this race quite distinct from any other. The principal variation is seen in the very pale reddish tint, with scarcely a trace of dusky, which is especially noticeable in the streakings on the breast.

Another phase from Camp Harney, Oregon, is remarkable for its pale grayish tints. Such inter-races are doubtless the result of causes very local in their action, and are so slight and inconstant as to deserve nothing more than passing notice.

Reaching the foot-hills of the Sierras we find *fallax* beginning to assume new characters, and in the mountains and along the western foot-hills it finally merges into var. *heermanni*. This form is characterized by a much darker shade of brown than either *fallax* or *melodia*, and by a bill much stouter than the former, but less robust than the latter. *Heermanni* has usually been considered the Californian song sparrow, the term thus including indifferently the birds both from the coast and the interior. But this is a mistake. The type now before me came from Fort Tejon, and it is in the interior only that the style to which this name was applied is met with.

Reaching the coast, another form is for the first time encountered. This is the var. *samuelis*, of which the *gouldii* of Baird, as correctly determined by Mr. Ridgway, is the fall plumage. Hitherto some three or four individuals from the vicinity of San Francisco have been taken as representing all that was known of this race. But no fewer than forty-six specimens are now at hand that agree well with the type, and are unquestionably referable here. In point of fact, it is *samuelis* alone that occurs in summer along and near the Californian coast, and nearly all published accounts of the habits, nesting, &c., of the song sparrow of California are to be taken as referring to it. This form rests chiefly upon its small size, it being by considerable the smallest of all the races, and the very dark, almost black, color of its prominent streakings. But it is upon a basis of size alone that it can be separated from *heermanni*, both agreeing in essential points of coloration. In fact, the question might well be raised whether it is necessary to recognize by distinct names two forms from this region. I have on the whole deemed it expedient to do so, as the difference of size, especially of bill, in specimens from the respective habitats of the two, as indicated, is pronounced and quite constant, readily sufficing in the great majority of cases for their identification. Thus in over thirty specimens of *heermanni* from Stockton, Cal., kindly furnished by Mr. Belding, I find no marked differences, and all the individuals from the interior that have been examined, representing many localities, agree in large size, the average being considerably in excess of those from the coast. A series of nine males, collected about Oakland, for the opportunity of examining which I am indebted to the courtesy of Mr. D. S. Bryant, of San Francisco, are similarly constant to the coast type so far as size is concerned, but vary somewhat in coloration. The differences are chiefly as to the number and size of the black streakings below, two of the nine being the darkest, and, on the whole, the most typical examples of *samuelis* I have seen.

Of the var. *mexicana* Ridgway, from Southern Mexico, little can be said, since the name rests upon a single specimen. This individual appears to be recognizable from the other races by its rather peculiar coloration, the streakings being very broad as well as black, and by its small size. More specimens are necessary to determine its true relations.

Var. *guttata* next invites attention. This is characterized by a darker, more rufescent type of color; the streaks on the dorsum are very indistinct, in some almost wanting. The bill is proportionately more slender than in any of the preceding forms.

The typical home of this variety is the Columbia River region, coastwise. But long before reaching that point evidence is afforded by specimens of intermediate character of the change to appear farther to the north. Thus fall and winter specimens from Nicasio, evidently reared farther north, are unquestionably intermediate in coloration between *samuelis* and *guttata*, while during the past season specimens were obtained by the expedition in Oregon upon the eastern slope, thus approximating the habitat of *fallax*, that are no less intermediate between that central region form and *guttata*, the two forms to the northward evidently passing, by insensible stages, into the latter.

Var. *rufina* is simply *guttata* with the tendencies of the latter carried a step or two farther, with increase of latitude. The rufous of *guttata* in extreme cases becomes a reddish sepia brown; the size is somewhat larger, the bill rather more slender. This is *rufina* as found about Sitka and southward.

Upon certain of the Alaskan Islands occurs *insignis*. This gigantic sparrow is distinguished, in addition to its great size, by a much paler, grayer phase of color than its nearest geographical neighbor, *rufina*. The streaks, instead of being nearly or quite obsolete, as in that form, are well defined and of an umber brown.

Of *insignis*, Baird and Ridgway say: "Between *M. melodia* of the Atlantic States and *M. insignis* of Kodiak the difference seems wide, but the connecting links in the inter-regions bridge this over so completely that with a series of hundreds of specimens before us, we abandon the attempt at specific separation." * * * It cannot be denied that the var. *rufina* from Sitka is nearer *insignis*, by many degrees, than the *melodia* of the East, and, as has just been indicated, nothing is wanting in the chain of evidence to establish the connection between *rufina* and *melodia*. But, while admitting the possibility that the relations between *insignis* and *rufina* may be as close as that of races, we feel justified in asserting that the inter-gradation, necessary to establish this, cannot be shown from the material accumulated up to the present time. Measurements appended below demonstrate that between the largest specimen of *rufina* in the collection and the smallest of *insignis* there is a very wide gap. Nor does there appear to be any known law of geographical variation to account for this.

As has been stated, and in conformity with a well-known law, increase of latitude seems to be accompanied by a general increase of size. But this fails of application in the case of *insignis*, since Sitka, the typical locality of *rufina*, is in the same latitude with Kodiak; while one specimen of *rufina*, by no means the largest, is present from Lituya Bay, which is slightly farther north than that island.

Possibly its insular habitat may be deemed sufficient to account for the marked characters of *insignis*, since in their power of impressing peculiar features upon their zoological inhabitants, islands seem to have a law of their own.

Color alone considered, although in this respect *insignis* is well marked, the step from *rufina* appears inconsiderable when it is remembered the great change that has been traced between *rufina* and *melodia*. The gap in size is much more important. Analogy in cases like the present has proved far from being always a safe guide, and since, by the test of inter-gradation, the only reliable one, *insignis* remains widely apart from the others, I deem it far safer to allow *insignis* to stand upon its merits until its claim to distinct specific rank be actually disproven.

Measurements are appended to show the average size of the various races; the largest and smallest individuals of each series are also given.

	Wing.	Tail.	Bill.	Tarsus.	Depth of culmen.
M. melodia (average of 21 specimens)	2.60	2.80	.46	.83	.30
Largest	2.77	2.90	.47	.78	.29
Smallest	2.32	2.60	.45	.78	.30
var. fallax (average of 23 specimens)	2.69	2.94	.44	.84	.25
Largest	2.92	3.17	.43	.83	.27
Smallest	2.35	2.52	.43	.77	.25
var. heermanni (average of 13 specimens)	2.61	2.82	.45	.84	.28
Largest	2.80	2.93	.46	.84	.28
Smallest	2.45	2.70	.45	.83	.24
var. samuelis (average of 46 specimens)	2.41	2.48	.45	.84	.26
Largest	2.60	2.64	.45	.86	.26
Smallest	2.13	2.23	.40	.76	.23
var. mexicana (one specimen)	2.52	2.83	.46	.87	.26
var. guttata (average of 23 specimens)	2.63	2.89	.44	.90	.26
Largest	2.78	3.14	.46	.93	....
Smallest	2.42	2.59	.45	.83	....
var. rufina (average of 7 specimens)	2.78	2.87	.48	.92	.26
Largest	2.96	3.12	.52	.93	.29
Smallest	2.61	2.64	.43	.87	.25
M. insignis (average of 20 specimens)	3.26	3.39	.61	1.07	.30
Largest	3.40	3.40	.50	1.13	.32
Smallest	3.13	3.35	.57	1.07	.29

M. melodia fallax (Baird). Rocky Mountain Sparrow.

This form was met with at several localities at the foot of the eastern slope, although it is along here that the change towards the *heermanni* type is first indicated; some specimens, indeed, from near Carson, Nev., appear to be referable to the latter variety.

M. melodia guttata (Nutt.). Oregon Song Sparrow.

If the song sparrows taken in Oregon at the base of the mountains in September are summer residents, as is doubtless the case, then the habitat of this race includes a restricted portion of the eastern slope. The specimens alluded to, from Warm Springs Agency and Crooked River, while not typical, are nearest to the above race. At The Dalles, on the Columbia, in October, these birds were extremely abundant in the hedgerows and brier-patches and along the small streams. At this locality the specimens were nearly typical *guttata*.

PASSERELLA Swainson.

P. iliaca megaryncha (Bd.). Thick-billed Sparrow.

This curious sparrow is present along much of the eastern slope in summer, and probably reaches quite to the Columbia River. It was first seen near Carson, Nev., May 16, being at this date found in considerable numbers in the wild-cherry brush along the cañon sides. It was apparently still on its way north, although Mr. Ridgway states that the bird begins to move north about the 1st of March. At a later date I found the birds quite common in the scrub on the top of Thompson's Peak, at an elevation of rather over 7,000 feet; and by the last of July fully fledged young were taken. The bird is eminently a mountain form, thick brush being the prime essential to its choice of a home. It never, I think, descends into the low valleys, which, on the other hand, seems to be preferred by the allied form *schistacea*.

HEDYMELES Baird.

H. melanocephalus (Sw.). Black-headed Grosbeak.

By May 15 this species was very numerous about Carson, and appeared to be mating. Their food at this season appears to consist largely of the soft buds of various shrubs, especially of the willows.

How far north the species goes I am not aware, my note-book simply furnishing the statement of its presence in Northern California, but in much diminished numbers. As it reaches Fort Steilacoom along the coast, it may attain a similar latitude in the interior. Its habits of nidification appear to be everywhere about the same, and to correspond pretty closely with those of the rose-breasted. Its architecture is of the simplest kind, the nest being made up of fine weed-stalks and similar light material, which are arranged in as circular a form as the stiff, unyielding nature of the stems will allow. A lining of fine rootlets disposed in a shallow circular form completes the structure. This is almost always placed toward the extremities of the lower limbs of trees, often overhanging a stream or deep ravine; more rarely the nest is placed on bushes.

Three eggs are occasionally laid, more usually two. They are light blue, irregularly spotted with reddish brown and purple; usually, though not always, most thickly at the larger ends.

Considerable variation in size obtains between sets. Two measure 1.05 × .73, 1.02 × .75, and .95 × .67, .93 × .68.

CYANOSPIZA Baird.

C. amœna (Say). Lazuli Finch.

A common summer resident about Carson, but met with less frequently toward the north. Nevertheless, Cooper reports it from Puget Sound, and Suckley found it in numbers in spring at The Dalles, Oregon. It was found by us to breed up to an altitude of 7,000 feet.

PIPILO Vieillot.

P. maculatus megalonyx Bd. Long-spurred Towhee.

This, the only form of the towhee met with by us, is extremely numerous along the eastern slope as high as the Columbia River. I fully agree with Mr. Ridgway that specimens of the *Pipilo* found along the eastern slope of the Sierras are absolutely indistinguishable by external characters from *megalonyx*. They appear to show no approach to *oregonus*, as that variety is illustrated by individuals from the northwestern coast. Nor have I been able to find in the habits, songs, and notes of the *Pipilo* of the Sierras the striking peculiarities which had such weight with Mr. Ridgway as to induce him to identify it as *oregonus*, in the face of its apparent likeness to *megalonyx* in form and colors. On the contrary, the habits of the towhees, as they have fallen under my notice in the Rocky Mountains and in the Sierras, have appeared to be essentially the same. Mr. Ridgway was especially impressed with the fact that the mewing call, which all observers have attributed to *megalonyx*, was never heard by him from the form found near Carson. But a line in my note-book records the fact that this same mewing note was the *only* one heard by me at this locality. Cooper, however, says that the call-notes of these two forms are alike, so that they have no distinctive value.

In the matter of birds' habits, differing circumstances of observation enter so largely as factors in the results obtained by different observers, that such evidence becomes, at best, but a precarious means of discrimination, especially between birds closely related; as, for instance, the members of the genus *Pipilo*. Apparent discrepancies in records are by no means always, perhaps, in fact, only in comparatively rare instances, attributable to inaccuracies of observation. But too often the fact is overlooked, or practically ignored, that in birds of the same species, at the same locality, and even at the same time, there may be a very marked diversity of habits, which is an expression of nothing more or less than individual taste or the result of quite adventitious circumstances. Such being the case, it is scarcely to be wondered at that in distant localities, where the observer is ever on the alert for new facts, he should, not infrequently, be misled into false comparisons by a note new to his experience, or some hitherto unnoticed habit, which, perhaps, had it been marked nearer home, would have attracted but casual attention.

By the above, however, it is by no means intended to imply that such matters are not entitled to a place as aids to the proper understanding of the relation of species to each other. It is doubtless true that there is occasionally to be noticed certain changes in respect to the habits and songs of birds that accompany changes of locality, and which may furnish the first clew to external variation, in support of which they may be adduced as additional and valid testimony. But it is no less true that the purely individual variation in birds' songs and habits is often very great; in truth, such appears to be the rule rather than the exception; a fact which should be kept fully in mind when such features are made to enter into the question of specific or varietal distinctions.

P. chlorurus (Towns.) Green-tailed Finch.

This sparrow is rather numerous in summer along the eastern slope, and reaches well into Oregon, if not, indeed, to the Columbia River.

Several nests with eggs were found in July.

ALAUDIDÆ—Larks.

EREMOPHILA Boie.

E. alpestris chrysolæma (?) (Wagl.). Horned Lark.

The usual central region form of the horned lark occurs rather numerously about Carson in summer upon barren pasture lands, sage brush, and alkaline flats, &c. Its breeding range extends into Southern Oregon, and perhaps even farther northward.

It appears to me that the identity of this central region form with the chrysolæma of Mexico is open to doubt and that its true place may be elsewhere. Pending an examination of the question, however, I employ the name in current use.

ICTERIDÆ—Orioles.

XANTHOCEPHALUS Bonaparte.

X. icterocephalus (Bp.). Yellow-headed Blackbird.

This blackbird is extremely abundant in all suitable localities along the eastern slope far towards the Columbia River. In the latitude of Carson, it begins to breed somewhat before the middle of May, and by the 15th the tule beds, to which it always resorts, will be found to contain nests in all phases of construction, while a few pairs, more ardent or enterprising than the rest, possess their full complement of four eggs. By the 1st of June nearly every nest contained eggs in various stages of advancement, while in not a few instances the young had already made their appearance.

The habit of colonization at this period is carried in this species to an extreme not observable in any other of the family, unless, perhaps, it be the tri-colored, as that bird is found in Southern California. Thousands flock together to form a happy, noisy community, their songs filling the swampy recesses with a confused and indescribable medley. Though by no means melody of a high order, they fall not unpleasantly upon the ear rightly attuned to bird music, when they are correctly interpreted as a mere rendering into audible sound of the overflowing jollity and good humor of the birds as they trill forth the notes in a happy-go-lucky sort of style from the swaying reeds.

The nests, while usually built well up on the reeds and fastened to the upper stalks, are not always so situated, but are occasionally, as was noticed in several instances at Washoe Lake, placed close to the marshy ground among the coarse grasses. When such is the case, the structure is very similar to that of the common red-wing under like circumstances. As the nests so placed were among the earliest found, it is probable that the more usual positions—high up on the reeds—is exchanged for one affording better protection and security for the early broods.

Dr. Coues tells us that the males appear to desert the females during the period of incubation. But if this be a matter of observation, I think it is, to say the least, unusual. I have found the males of this species as domestic in their habits and as assiduous in attention to their young as any of the family. It is true, as observed by Mr. Nelson, that they are much shyer than their mates, the natural result of their more conspicuous colors and their distrust of danger on account of this. They are hence less often seen about the nest when it is disturbed.

AGELÆUS Vieillot.

A. phœniceus (L.). Red-winged Blackbird.

An abundant summer resident along the eastern slope. More or less winter about Carson.

A. phœniceus gubernator (Wagl.). Red and Black-shouldered Blackbird.

This form is less abundant than the former as well as less generally distributed along the eastern slope. It appears, as a rule, not to be found much east of this line, but it is reported from Camp Harney, Oregon, by Captain Bendire. It is noticeable in this connection that none of the specimens which are referable to this form from localities east of the mountains represent it in its typical condition. Thus from the neighborhood of Reno, Nev., at the eastern base of the Sierras, close to the border of California, we have a series of specimens the males of which have the crimson shoulder-patch bordered narrowly with light buff, *each feather of which border is black-tipped.* Such individuals appear to be just about half-way in development towards *gubernator.* It is interesting to note that in this same locality the *A. phœniceus* is also present (both breeding), and in as truly typical dress as anywhere in the West. What proportion of individuals represent either form I cannot say, but believe that by far the largest percentage of the *agelæi* here are *phœniceus.*

It would thus appear as though the eastern blackbird extends to about the line of the mountains unchanged; that here, the influences, as of climate, &c., first begin to be felt, which, only partially operative here, as they become intensified farther to the west result in effecting the color change which is seen in typical *gubernator.* In this instance it would appear that the influences are sufficiently strong to affect only a proportion of individuals, which from obscure reasons are more susceptible to their workings; while the majority remain true to their type.

If, as is usually understood to be the case, color varieties are identifiable with certain limited areas of distribution, it follows that, as in the present instance, where the species inhabits continuously a wide region, the changes of environment are more or less gradual, and hence at certain points or along a certain line of distribution it is brought under conditions which are intermediate in character and force—a sort of neutral ground, as it were. From such regions come the specimens which, though often the cause of no little perplexity to the naturalist from the difficulties in the way of their proper identification, are yet full of interest as furnishing indubitable proof of the intergradation of forms.

STURNELLA Vieillot.

S. magna neglecta Aud. Western Meadow Lark.

Very numerous throughout this whole region.

Most of the nests discovered were arched over, thus conforming to the usual plan of structure. In one instance the birds seemed to find the protection of the tall grass an ample safeguard, and the nest was merely a flat open structure, with no attempt at a roof.

ICTERUS Brisson.

I. bullocki (Swains.). Bullock's Oriole.

Very numerous about Carson and to the northward along the base of the mountains up to the Columbia River.

Begins to nest about Carson about the middle of May. After their arrival and during the early part of the summer, the orioles in this locality appear to obtain but very little of their subsistence among the trees, but resort in pairs to the hillsides, where on the ground among the sage bushes they appeared to glean a full harvest. The exact nature of this I did not ascertain; it is probably though some species of worm or caterpillar that infests these plants.

SCOLECOPHAGUS Swainson.

S. cyanocephalus (Wagl.). Brewer's Blackbird.

This blackbird is extremely abundant throughout this whole region as a summer visitant, while more or less remain through the winter.

Elsewhere, as in the Rocky Mountains, I have found little disposition on the part of this species to gather into communities at the breeding season. But in this region it is comparatively unusual to find this blackbird breeding in other than large colonies, and I have found a dozen nests in the space of thirty or forty yards.

The eggs of no one of our birds are subject to greater extremes of variation than those of the Brewer's blackbird. The differences are apparent not only in the amount of markings and their particular shade and character, but also include much variation in size and shape.

CORVIDÆ—Crows.

CORVUS Linnæus.

The question of the existence in the Pacific province of a species or variety of crow different from *americanus* and *ossifragus* is an interesting one, and a discussion of some of the points involved will not be uninteresting, even if an entirely definite and satisfactory conclusion respecting the relationships of the eastern and western birds be not reached. The name *caurinus* was proposed by Professor Baird in 1858 for a crow inhabiting the northwestern coast, and specimens were cited from Puget Sound and Washington Territory. The characters of the supposed species rested mainly upon its smaller size, together with certain peculiarities of habits and notes. But from the first, the exact habitat and status of the new species appears to have been somewhat doubtful, as at the time of description the above author included under *americanus* a number of specimens from contiguous regions in California and Washington Territory, their distinctness from the newly-described *caurinus* being assumed entirely on account of their large size, no other differences being discernible.*

Since then the different habits and notes of the crows of the Pacific coast have been remarked in turn by nearly every observer who has visited that region, and appear to have been the main cause of the retention of *caurinus*, either as a distinct species or a geographical race of the common crow. In fact, habits and notes aside, no one appears to have been able to find a single tangible character by means of which the so-called *caurinus* was to be recognized.†

Thus Captain Bendire, in his list of Camp Harney birds, in which he gives *caurinus* as a "rare summer resident," remarks: "If it were not for their [that is, *caurinus* and *americanus*] totally different habits, I could see no really good reasons for separating this species."

Dr. Cooper seems to have been equally doubtful of the relations of *caurinus*, and says, in "Birds of California," "I am now satisfied that there is but one species of crow on this side of the continent, and, if distinguishable at all from the eastern, it is by its smaller size, less graduated tail, more gregarious habits, and different voice." In conformity with this view, he includes in the habitat of *caurinus*, not only the Pacific coast, but the region "east to the northern Rocky Mountains," thus entirely excluding *americanus* from the Pacific region.

Assuming the position taken by Dr. Cooper, that but one species of crow is represented upon the west side of the continent, I have been able, after a careful examination and measurement of all the material afforded by the Smithsonian collection, to verify the statement of the smaller size of the crows from the Pacific States *only as a slight average*, while among specimens from this region are some of the *largest* individuals I have seen—three, respectively from Tulare Valley, Southern California; Fort Crook, Northern California; and Camp Harney, Oreg., being matched in size by but few from the Eastern States. Nor do the strictly coast-inhabiting birds appear to be much, if any, smaller than those from interior districts. At least they are not constantly so, since Dr. Cooper says "the smallest specimens I have seen were collected by Mr. F. Gruber on the west slope of the Sierra Nevada, about latitude 38° 30′."

The shape of the tails of west coast specimens appears to vary in no particular from eastern, and I am fully convinced that it is in vain to attempt to separate the crows of California, Nevada, Oregon, and probably Washington Territory from *americanus* by definite and reliable external character, the range of that species, therefore, in my opinion, embracing the Pacific as well as the Central region.

But from the region north of Washington Territory the crows appear to undergo a general diminution in size, this being especially marked in respect to the length of tarsus; all the specimens at hand from the northwest coast (including one from Shoalwater Bay) agree in small size and extremely short tarsus. The general size of these birds is but little in excess of the average of *ossifragus*. But in no other particular are they like that species, being, in fact, save in the one particular of size, indistinguishable from eastern *americanus*. It was remarked by Professor Baird that the *Corvidæ* appear to form an exception to the general rule, and that "the same species in southern localities are larger than those from points farther north." This statement will require qualification in the case of *Corvus var. floridanus*, which, while averaging in general size a trifle smaller than Northern-born birds, yet offers, in the increased size of bill and feet, a marked contrast to them. But as applied elsewhere in the United States the statement appears to hold good, and especially on the other side of the continent, where a decrease of size with increased latitude appears to be the rule. Possibly this simple statement of fact is all that the difference in size exhibited by the crows of the extreme northwest requires.

As considerable stress has been laid upon the different habits of *caurinus* it may be well to consider these briefly; and, first, it is to be remarked that nearly all the differences in habits and notes appear to apply as well to the crows found throughout California, Oregon, and Washington Territory as to those of the region to the north, while, as has just been stated, it is only in the latter region that these are accompanied by a single salient character that will serve to identify the skins.

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* Prof. Baird further remarks of *caurinus*, after enumerating the points by which it may "readily be distinguished from the eastern fish crow," "it is so much like the *Corvus americanus* as to be only distinguishable by its inferior size and habits. Indeed, it is almost a question whether it be more than a dwarfed race of the other species."

† In the recent work, "Birds of North America," by Baird, Brewer, and Ridgway, a further distinctive feature is assigned to *caurinus*, viz, the fact that the tarsus is shorter than the bill. But this statement resulted from an incorrect method of measurement, as Mr. Ridgway now informs me, the tarsus being measured on its anterior surface, at the end of the feathering, instead of from the joint, thus giving a length too short by a very appreciable amount. With the exception of the diminutive Mexican species (*C. mexicanus*) all the North American crows agree in having the tarsus longer than the bill.

If habits be taken as the test, then all alike—those from the far interior of Oregon as well as from the coast, from California northward—must be held to be *caurinus*, although, as has been stated, a large proportion of specimens from Washington Territory southward absolutely differ in no particular of form or color from others from the Eastern States.

If, on the other hand, small size, as exemplified especially in the short tarsus, be held sufficient to characterize the race, then those only from north of Washington Territory are eligible to the name; and all from below, although sharing in the habits which have been held to distinguish *caurinus*, must be considered as *americanus*, notwithstanding, too, the additional fact that the measurements of some few of the smallest of these latter approximate somewhat closely to Alaska specimens.

It may be added that while observers agree in the general statement of the possession by the so-called *caurinus* of peculiar habits, the accounts of each vary as to the details, change of locality evidently producing a corresponding change in habits. Thus the domed nests, made of mud, which *caurinus* is said by Lord to build about Sitka, differ entirely from those found by Bendire in Oregon, and by Cooper in California, which resembled the usual style of the common crow. Nor do the piscivorous habits of *caurinus* offer anything very distinctive, since they are shared by the common crow of Florida (*var. floridanus*), which there has many of the ways of the true fish crow (*ossifragus*). About Washington, too, the common crow and fish-crow go in associate bands, and their notes alone can be relied upon to identify them as they feed together along the river. As further evidence of the varying habits of the crows, it may be stated that in this locality the fish crow in turn often abandons its usual littoral haunts for the plowed fields and pastures of the interior. In fact, with birds possessing the omnivorous taste of the crows it appears to be quite a matter of accident that determines their hunting grounds, those where food is most abundant and readiest at hand being the favorite; hence, of course, its nature varies indefinitely with locality and circumstances.

The alleged more pronounced gregarious habits of *caurinus*, even allowing all that is claimed, are probably but the result of exceptional conditions, and appear to be carried in the northwest but little farther than is observable in the common crow at the East. Even on the Pacific coast the habit of breeding in colonies is far from universal. When such colonies are formed they are as likely to be the result of necessity as of choice. As, for instance, when favorable breeding grounds are scarce, a more or less extensive colonization must necessarily follow, which is less marked when other conditions prevail.

As to notes, this much may safely be stated, that some, at least, of the crows of the Pacific province have a note different from the usual one of *americanus*. As Dr. Cooper says, this "differs rather in tone than in character." In other words, it is the old-fashioned caw, but uttered in a different tone. In Southern California, near the coast, and in Oregon, east of the mountains, I have on many occasions heard this note, which has strongly suggested that of *ossifragus*, and which I then took for granted as belonging to *caurinus*. But in every such instance the well-known ringing caws of *americanus* were recognized from the same flock. Of six or eight individuals shot from these flocks all proved to be indistinguishable from *americanus*, and at the time I presumed the particular individuals of *caurinus* must have escaped me. Now, however, I feel tolerably well assured that all alike were *americanus*, the notes varying in individuals. Mr. Ridgway, on the other hand, informs me that in his experience in the Sacramento Valley, Nevada, &c., he never heard any but the common note of *americanus*.

In conclusion, the general tenor of the change of habits of the Pacific crow, so far as any are to be noticed, is in the direction of the fish crow (*ossifragus*), and by at least one author the two have been regarded as identical. But in the proportions of certain parts and in colors they are very distinct from *ossifragus*, which may readily and infallibly be distinguished from the common crow from whatever locality by a number of well-defined characters.

At present I deem it, on the whole, advisable to recognize a race of the common crow from the extreme northwest coast, from Puget Sound northward, assigning, as characters, small size in general, and especially a short tarsus, at the same time admitting the possibility that a larger series from the region in question, together with additional data concerning habits, &c., may suffice to show its distinctness as a species. On the other hand, I am assured that no features are to be found attaching to the crows, either of the west coast or interior south of the above-mentioned point, that will warrant the maintenance of a name. They, at least, are *americanus*.

A series of measurements is appended below to afford means of comparison of the crows of eastern and western United States.

MEASUREMENTS.

	Wing.	Tail.	Bill.	Tarsus.
AMERICANUS.				
East of Rocky Mountains:				
Average of 25 specimens	12.36	7.24	1.85	2.39
Largest individual (Massachusetts)	13.00	7.45	2.00	2.60
Smallest individual (New Mexico)	11.50	7.00	1.72	2.25
California and Oregon:				
Average of 6 specimens	11.78	7.21	1.78	2.30
Largest individual (Fort Crook, Cal.)	12.90	7.95	1.95	2.23
Smallest individual (Stockton, Cal.)	11.00	6.80	1.60	2.23
VAR. CAURINUS.				
Puget Sound, Alaska:				
Average of 7 specimens	10.82	6.68	1.70	2.00
Largest individual (Puget Sound)	11.60	7.25	1.88	2.12
Smallest individual (Alaska)	10.25	6.00	1.68	1.95
VAR. FLORIDANUS.				
Florida:				
Average of 4 specimens	12.05	7.12	2.04	2.49
Largest individual	12.50	7.25	2.10	2.50
Smallest individual	11.45	7.00	1.93	2.42

C. carnivorus, Bartr. American Raven.

A resident species; more or less common everywhere save in the higher mountain districts.

Pyramid Lake, Nevada, forms a favorite resort for ravens during the summer, as the perpendicular and inaccessible cliffs about certain parts of the lake present an abundance of sheltered ledges and cavities where they love to place their nests. I noticed that in one spot several pairs had built within the space of a few yards, a somewhat unusual circumstance, as ravens are not apt to be socially inclined at this period.

C. americanus, Aud. Common Crow.

Although by no means as generally distributed in the far West as in the Eastern States, the crow is yet found in probably each and all of the States and Territories west of the Mississippi. At all events it has not been wanting in any of those entered by our parties.

Whether its presence in the more remote Western States, as affirmed by many of the settlers, is a comparatively recent event, or whether the cultivation of the wilderness and the orchards and grain fields that have succeeded the advent of the pioneers have simply been the means of bringing the crow into direct contact with man, and so of making its presence felt, are questions not easy to determine. I am inclined to believe, however, that the crow had made good a squatter's right to the country long before the date of the white man's possession, and to attribute its present unquestionably greater abundance in sections and territories where at first it was unnoticed to the fact of the concentration of the species into civilized districts, where its sagacity soon taught it a living was to be had the easiest.

I have never heard laid to the door of the crow the charge of any serious depredations on the corn and grain fields of the new Territories, and fancy that the knavish tricks of its eastern cousins, that have earned them so bad a name, have not spread so far—possibly another reason for supposing that the western birds are not recent migrants from the east, else surely they had not left behind such profitable tricks as pulling up newly-sprouted corn and other devices of a like nature. Doubtless its natural food here is more abundant, and hence, the struggle for existence being less sharp, the crow finds it less needful to employ its wits to the end of getting a living at other folks' expense.

In Oregon, especially east of the mountains, crows are very numerous indeed, and I saw many large flocks on the various cattle ranges, as well as, later in fall, on the stubble fields. Meadowy pasture land and the vicinity of streams are the favorite resorts. The only difference between them and the "Jim Crow" of the east that I could detect was, at times, a difference in the cawing note, which, however, as stated above, seemed to attach only to individuals, the greater number in the various flocks holding to the old-fashioned caw.

The "smell for gunpowder" has evidently not been cultivated to the extent that is popularly attributed to the New England crow, and it proved a comparatively easy matter to obtain specimens. However, what crows, no matter where hatched, don't know about taking care of themselves is very soon acquired, and a very little experience will be found to go a long ways with them. Naturally the crow is no shyer than other large birds, and its extreme wariness at the East, instead of being an indication, as some writers are prone to construe it, of a natural trait, is simply due to persecution, and to it alone.

PICICORVUS Bonaparte.

P. columbianus (Wils.). Clarke's Crow.

A constant and abundant resident of the pineries.

GYMNOKITTA Maximilian.

G. cyanocephalus (Maxim.). Maximilian's Jay.

A numerous and constant resident of the low ranges of piñon hills. Along much of our route from Northern California northward along the base of the Sierra and Cascade Ranges this jay was entirely absent, the nature of the country being unsuited to its peculiar economy. At certain points in the Des Chutes Basin, however, it was noticed in great numbers. Here they were feeding upon a purple berry, the source of which I could not ascertain, but of which their crops were full, as well, too, upon the seeds of the yellow pine.

I am indebted to my friend Mr. H. G. Parker, of Carson, Nev., for an account of the nesting habits of this jay in his neighborhood. He informs me that late in March thousands breed upon the piñon hills, the colonies consisting of a variable number of pairs; occasionally isolated nests are found, but this appears to be rather exceptional. Eggs were taken April 10.

The single nest he has sent for examination shows an unexpected degree of taste and skill in the arrangement of the material, which is drawn very largely from the piñons. An external base of twigs, which appear to have been broken off from the ends of the branches, affords firm support for the nest proper, which is a compact, deeply hollowed cup, made of strips and shreds of bark from the sage bush. Finer strippings of the same with a few straws complete the lining.

The nest is usually placed near the top of the tree, sometimes near the extremities of the branches, occasionally close to the trunk. In any event it is but a few feet from the ground, for the piñon rarely indeed attains a height of twenty feet.

The coloration of the eggs is very peculiar, and they are unlike those of any other jay that I have ever seen. They are greenish-white, marked with numerous spots of brown and purple. As usual, this latter tint is due to the overlaying crust of shell, and is not, strictly speaking, a normal color. The markings are thickest at the greater ends, and tend towards aggregation in circles. A set of four eggs measure $(1.27 \times .87)^2$, $1.27 \times .88$, $1.27 \times .87$.

PICA Vieillot.

P. melanoleuca hudsonica (Sab.). Magpie.

In the settled portions of Nevada and Eastern California of slight elevation, and especially in the wooded tracts that mark the courses of the streams, the magpie is a constant resident, and one which, from its size and general conspicuousness, is not liable to be overlooked. The thickets along the Carson River serve as favorite breeding grounds for great numbers of this species; in fact, I have never seen it more abundant than here.

As noisy and as easily irritated into vociferous demonstration as is the magpie under ordinary circumstances, no sooner has the breeding season fairly begun than, under influence of the new feelings and emotions that have sprung into existence, our magpie seems to lose its voice, and, from being one of the most garrulous of the feathered community, subsides into a very quiet and matter-of-fact sort of individual, as if perfectly aware of the danger its usual boisterousness is likely to bring upon its home. To prove that this quiet demeanor is but a cloak assumed for a season, in obedience to an instinctive apprehension of danger, it is only necessary to approach with too curious eyes the nest of one of a community of pairs, especially if it chance to contain young. Under such circumstances the intruder will find himself the target for imprecations and anathemas, delivered with such unction and effect from a dozen angry throats, that he will probably be glad to finish his investigations in a hurry and retire from the ground. In such a strait the pairs make common cause, and their audacity is in strong contrast to their usual wariness.

In the neighborhood of Carson every thicket of sufficient density to screen its bulky nest contains one, oftener several, of the structures, that are so characteristic as to at once proclaim their ownership.

While the magpie is to no inconsiderable extent a sharer in the natural cunning, so justly attributed to its relatives the crows, a fact in its history now and then comes to notice which would appear at first thought to negative the possession of this trait; as, for instance, the place and position in which their nests are occasionally found. Not only do these often seem to be imperiled by their proximity to the ground, being sometimes but a foot or two above it, but at times not the slightest attention will be paid to their concealment. I have in mind a certain point along the Carson River where some dead trees are found, in which the magpies have nested for apparently a long period, and where their nests are visible for a distance of many hundred yards. But as a matter of fact the eggs or young are less liable to danger than would at first thought be supposed, and doubtless experience has taught the birds this. In selecting sticks and twigs for the outer nest the magpie, probably by design, chooses such as, from their scraggly, thorny nature, they are enabled to so firmly interlock that all chance of forcible entry except through the small aperture in the side left for the purpose is cut off, and every foe provided against except man alone. Indeed, I have myself, more than once, found it a far from easy matter to gain the interior through this thorny barrier.

So far as humans are concerned the magpies have but little to fear, as their marketable value, fortunately for themselves, amounts to next to nothing. For, notwithstanding the fact that they may, when taken in hand young, be readily tamed and, after the proper manipulation, be taught to talk, they are so noisy and their dispositions so extremely mischievous, that a short experience usually results in their being voted a nuisance, and hence they stand in low favor. So a few taken for pets and an occasional nest destroyed by mischievous boys sum up the dangers of the magpie's housekeeping.

The labor of this is pretty evenly divided. Upon the females devolves the main task of incubation, relieved now and then by their partners. The latter are away from home most of the time busily occupied in foraging, since not only have they their own appetites to appease, but it is their duty to provide for the females engaged in their enforced duty. Upon the appearance of the young both birds share equally in attention to their wants.

About Carson the eggs are not deposited before the 1st of March, but as late as the 12th of May quite a number of nests were found to contain fresh eggs.

CYANURA Swainson.

C. stelleri frontalis, Ridgw. Blue-fronted Jay.

This form of the Steller's jay has been traced by the expedition from the Coast and Sierra Ranges of Southern California into the Cascade Mountains of Oregon, and so on up to the Columbia River, at which point, however, the form does not cease, but continues into Washington Territory.

As is well known, this bird is represented in the Rocky Mountains by the long-crested variety, in which the streaks of the forehead are of a faint bluish-white instead of blue, and the upper eyelid is conspicuously patched with white. Two specimens collected at the base of the Cascade Range are worthy of note in this connection, since, while they represent the normal *frontalis* type in every other particular, both show unmistakable traces of this white patch, which in one is quite conspicuous; a hint, as it were, of the new character to be assumed farther to the eastward.

A description of the young in first plumage is subjoined.

First plumage.—Above, dark plumbeous; head darker, *with no trace of blue streaks* on forehead; wings blue, barred with black, as in adult; belly light blue; breast and throat plumbeous; chin with light space.

CYANOCITTA Bonaparte.

C. floridanus californicus (Vig.). Californian Ground Jay.

Numerous in the brushy foot-hills to a considerable distance north of Carson, Nev. A single specimen, the only one seen, was taken at The Dalles, on the Columbia, October 4, and it perhaps occurs here and there over the intervening ground.

Nuttall found the species common at Fort Vancouver, on the west side of the Cascade Mountains, in October, and indicates its occurrence as far north as the Frazer's River. This was in 1834, and it appears to have escaped the observation of all the more recent explorers of the same region. Recently Mr. C. Roop, of Portland, Oreg., informed me that this jay is abundant near the mouth of the Willamette River, in both Oregon and Washington Territories.

All the specimens we have seen from along the western slope, although not typical of the above race, are best referable to it.*

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*In which connection see annual report of this survey for 1877, p. 1305.

A description of the first plumage of this form is added from a fledgeling taken at Eagle Lake, California, in July.

Prevailing color above, plumbeous brown; head with bluish cast; wings and tail blue, as in adult; below ashy white; feathers on throat and breast showing no traces of streaks; sides of head and an imperfect bar across breast dusky plumbeous. A conspicuous white line above and behind the eye.

PERISOREOUS Bonaparte.

P. obscurus, Ridgw. Oregon Gray Jay, "Meat Bird."

This bird was not recognized as distinct from the Canada jay (*P. canadensis*) until quite recently, when Mr. Ridgway described under the above name specimens from Shoalwater Bay, and indicated Washington Territory, Oregon, and the northwest coast generally as its habitat. Mr. Ridgway, however, included the form under head of *canadensis*, presuming it to represent the Pacific coast variety of that bird, as *capitalis* does the Rocky Mountain form.

A recent investigation, in connection with Mr. Ridgway, of a better series of specimens than was available when *obscurus* was described, leads to the belief that this form is entirely distinct from the Canada jay, its peculiarities being of a kind not explainable upon any theory of geographical variation. As good descriptions of *obscurus* are found elsewhere, I need here merely allude to its chief distinctive points, viz: the conspicuous white shafts of the feathers of the back and scapulars, and the ashy white under parts, tending to brown only along the sides. In these particulars it differs conspicuously from the others.

During the past season *obscurus* was found to be a resident of the mountains from Northern California to the Columbia River, its range being thus extended very materially. The young in nesting plumage were taken near Camp Bidwell, California.

My specimens from the above region agree with the types in essential respects; in fact the only difference appears to be in regard to the amount of white, especially on forehead, it extending farther back towards the occiput than in the coast examples, while the general tints also are lighter.

A comparison of specimens of the Canada jay from Alaska and Maine reveals considerable difference. In fact, extreme examples of the Alaska type appear to show peculiarities of color sufficient to warrant their separation as a variety. Even, however, in the small series from the former region in the Smithsonian collection, there is a very noticeable amount of purely individual variation, and some specimens cannot be discriminated from Maine examples. So that, on the whole, I do not consider the difference sufficient to justify a new name.*

That the Rocky Mountain form *capitalis* intergrades completely with *canadensis* there can be no doubt, although typical specimens of *capitalis* offer very tangible differences. In the northern Rocky Mountains, as in Montana, the peculiarities of this race very sensibly diminish, and the tendency towards the *canadensis* type is marked. From farther south and in its region proper, no specimens appear to be found which are not wholly characteristic of *capitalis*.

The following measurements express the variations in size between the forms:

	Wing.	Tail.	Bill.	Tarsus.
P. canadensis:				
Average of 6 specimens	5.61	5.93	.75	1.35
Largest individual	5.84	6.07	.83	1.45
Smallest individual	5.33	5.54	.73	1.33
Alaska specimens, *P. canadensis:*				
Average of 7 specimens	5.43	5.66	.77	1.33
Largest individual	5.67	5.65	.85	1.40
Smallest individual	5.10	......	......	1.26
Var. *capitalis:*				
Average of 10 specimens	6.04	5.99	.80	1.36
Largest individual	6.35	6.12	.82	1.40
Smallest individual	5.72	5.55	.73	1.34
P. obscurus:				
Average of 7 specimens	5.53	5.38	.71	1.31
Largest individual	5.78	5.58	.69	.321
Smallest individual	5.23	5.12	.72	.261

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* Since the above was written Mr. Ridgway informs me that he has given the name *fumifrons* to the Alaskan coast form.

will be noticed, Alaska specimens appear to average considerably smaller thai from Maine.

r. *capitalis* undergoes a decided increase in length of wing, without a corresponding ase in size of tail.

obscurus the proportions of wing and tail are reversed, it being the only one which he tail shorter than the wing.

bits.—As Northern California is reached, the Oregón gray jay becomes a familiar t of attention in the pine woods, of which it is a constant resident. Along the r Des Chutes River the "meat birds," as they are suggestively termed by the ers, were very numerous; so numerous, in fact, and so quietly persistent in their dance about the cook-fire, that they became positive nuisances. When they are ned towards familiarity, they carry their boldness to a surprising extent. Every ing about sun-up, from six to a dozen or more presented themselves in the trees hanging camp, and the momentary absence of the cook from his charge was cond as an invitation to the feast, and down they swooped upon the nearest morsel od. Almost everything edible seemed to be acceptable, although their preference aw meat was plainly evidenced. Finally, when the cook's patience gave out, the gun was brought into requisition, which diminished the number, without having visible effect in checking the rapacity of the survivors. Several were readily ht by means of a bent pin fastened to a string and baited with scraps of venison. are not always by any means so bold as in this locality, and a dark form, visible n instant as it flits noiselessly through the sombre pines, is often the only proof e presence of the species.

ave always found the Rocky Mountain gray jay to be a very silent bird. But species has a variety of odd notes, a sort of squeaking, whining call being the most non. Cooper also assigns this species a "considerable variety of song."

TYRANNIDÆ—Tyrant Flycatchers.

TYRANNUS Cuvier.

rticalis, Say. Arkansas Flycatcher.

very numerous summer resident. It was not observed by us farther north than hern Oregon, but doubtless this was owing to the lateness of the season, as it was by Suckley at The Dalles, and even farther north in Washington Territory. *carolinensis* was not met with, but, according to Mr. Ridgway, occurs in sum Western Nevada (Truckee Valley).

MYIARCHUS Cabanis.

ascens (Lawr.). Ash-throated Flycatcher.

on on the foot-hills near Carson, but apparently a rare summer visitant farth along the eastern slope. A single individual was seen at Honey Lake, Cal-

SAYORRNIS Bonaparte.

Bp.). Say's Flycatcher.

us along the eastern slope. This species is in the habit of building about outbuildings, in this respect being like the eastern Phœbe. A curioust nestected by one pair was a little niche in the sandy wall of a disused well, and ty feet or more from the top. The problem of getting the young up the ad yet to solve.

ricans appears not to be present in this region, although it is common to the mountains in Oregon.

CONTOPUS Cabot.

w.). Olive-sided Flycatcher.

her occurs in summer all along the eastern slope up to the Columbia bably still farther to the north. It does not appear to be as numerous Rocky Mountains, or even in the region west of the Sierras.

dsoni (Sw.). Western Wood Pewee.

mmer visitant of the mountains. A nest found June 26 contained two advanced.

r appears to vary the position of its nest, sometimes fork of a limb, at other times placing it on the broad upper surface—in other words, saddling it. The same variation in plan is observable in the nests of our eastern pewee, although in both, the latter method seems to be the favorite.

The nest alluded to above, as also a second found July 23, was saddled upon the terminal fork of a cottonwood, and was similar to the usual style of the eastern pewee, except that the exterior lacked the customary sprinkling of lichens given it by the latter bird. Instead it was dressed with shreds of a white cottony substance and gray fibrous bark, which served admirably to harmonize its tints with those of the light bark of the tree, precisely the same end being thus attained as effected by the other bird, each using the material best adapted to its own case. It would indeed be a "blind" instinct that should induce the western pewee to adopt for its nest the cloak of lichens, the invariable and successful resort of its eastern relative, an instinct that would prove fatal to the safety of its home, and only serve to invite the very danger of conspicuousness which it is its chief object to avoid. The contrast of differing means to the same end which is displayed in the architecture of these two flycatchers is one of many equally good illustrations which might be cited to prove the presence in birds of a something higher than mere hereditary instinct, and shows that only by granting the existence of an amount of reasoning power can we explain the readiness with which a species adapts its existence to new conditions, and the fertility of resource which prompts the choice of means to a necessary end.

EMPIDONAX Cabot.

E. trailii, Aud. Traill's Flycatcher.

Western specimens of this bird have usually been considered to represent a light-colored race, and have found mention under name of *var. pusillu*. I think Mr. Ridgway is correct in the view recently expressed,* and that western and eastern birds do not differ sufficiently to warrant their separation.

The *pusillus* of Swainson was accepted by Professor Baird as applying to the western bird, but apparently with some doubt, as Swainson's description applies almost equally well to *minimus*. I prefer, therefore, to fall back upon the *trailli* of Audubon, including under this name both eastern and western birds.

The Trails flycatcher is a numerous summer resident of the eastern slope, well up into Oregon. It loves to frequent the willow thickets along the streams, even following them to a high elevation in the mountains.

E. obscurus (Sw.). Wright's Flycatcher.

Apparently rather uncommon as a summer inhabitant of the mountains, where only it is found at this season. It appears in summer never to frequent the same situations as the preceding bird, although the two may inhabit the same general locality. Thus, the borders of a stream which meanders through an alpine valley, and which is hedged by willows, will be found, almost to a certainty, to be inhabited by the little flycatcher, while the present species never intrudes on the domain of this bird, but is contented with the hillsides above, where it lives under the pines and among the chaparral.

It would be interesting to study out the probable causes which thus lead two species so closely allied as these two flycatchers, with the same general habits and economy, with precisely the same method of capturing food, and living within sight, as it were, of each other, to so maintain their own preserves as never to clash with each other. A possible explanation suggests itself in varying tastes as to food, since it is probable that each locality differs enough in the character of its plants to harbor different kinds of insects, and hence to furnish each species with its own particular bill of fare.

A nest found June 22 contained four fresh eggs. These are yellowish-white, and unspotted. The nest was an extremely neat, pretty structure, composed externally of strips of white bark, with an internal lining of fine grasses and feathers. It had a depth of two inches, and an internal diameter of the same. It was singularly exposed to view, being placed on an open bush on a hillside, where it was overshadowed by large pine trees.

The *E. hammondi* is said to also occur along the eastern slope, but I did not meet with it.

CAPRIMULGIDÆ—Goatsuckers.

CHORDEILES Swainson.

C. popetue henryi, Cass. Western Night Hawk.

An extremely abundant summer visitant through California, Oregon, and into Washington Territory.

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* Ornithology of the Fortieth Parallel, page 539.

eral sets of eggs were found, which seemed to have been deposited on the ground azard, with little or no attention to special locality.

ANTROSTOMUS Gould.

ttalli, Aud. Nuttall's Poorwill.

he neighborhood of Carson the poorwill arrives from the south in the early days y. It soon becomes generally and commonly distributed over nearly all the ı embraced in the present report, being scarcely less numerous towards the north. Cooper and Suckley note its presence in the portions of Oregon and Washington ory, east of the mountains, and indicate negatively its absence to the west.

TROCHILIDÆ—Humming Birds.

STELLULA Gould.

liope, Gould. Calliope Humming Bird.

range of this diminutive humming-bird is now pretty well made out. It has een known as a resident of the west coast, and there extends over much of Cali- ı, Oregon, and Washington Territory, where in summer it is confined to the mount- To the eastward its summer habitat appears to be in general limited by the rn slope, along which, in Nevada, California, and Oregon, it was found by our par- be very numerous. In fall, at least, it reaches as far into the middle region as the Humboldt Mountains, where found in August by Mr. Ridgway. New Mexico and na, as determined by our parties, complete its limited range in the central regions ikewise its known dispersion within our limits. It may breed in the latter Ter- es, as specimens were obtained in July. That it does so along the eastern slope is no possible doubt, as about the middle of June, in Eastern California (Honey), I often saw the females most busily at work gathering stores of down from the w catkins, then hanging full, to weave into nests. I was left to conjecture that ocation of these was in the high branches of the firs and other evergreens, as I l to discover a single one, which could hardly have been the case had they been sitions at all accessible.

e males were at that season very restless and wary, and to procure specimens d no easy matter. The flower which here is most resorted to, not alone by this y other hummers, is a species of *Castilleia* which is found along the banks of most e mountain streams. Wherever these blosoms are numerous, the hum of wings ese busy little pilferers as they dart to and fro is constant.

mming-birds have, however, in this section, another and less usual source of food y, to which my attention was attracted while in the mountains near Camp Bid- For several of the early hours of morning I noticed that the humming-birds red about the upper branches of the firs and spruces, precisely as if feeding, to the e neglect of the flower-bordered streams which occupied their attention later in the As this is the time when they are hungriest, I could only account for their actions e supposition that they were feeding upon "honey dew." As this may not be famil- all my readers, I will state that it is a sweet saccharine substance that is depos- ıpon the foliage of trees and shrubs in many localities of this region by certain insects, the plant-feeding *Aphides*. It is often found in considerable quantities, nsiderable in fact that in some places, as I was informed, the Indians collect it by hing the plants after the sun has evaporated it into a sugar, and make use of it as That it is sweet and palatable, I myself can testify, and doubtless as much so e delicate taste of the humming-birds as to the human palate. In early morning, e the sun's rays have evaporated it, "honey dew" is found in a semi-liquified , and then would be as easily managed by the brush-tipped tongues of the birds as ectar of flowers. Without doubt, too, the birds secure many small insects which t to feed upon this substance.

re I wish to notice what I believe was an error of identification on the part of Dr. er when he mentioned the broad-tailed humming-bird (*S. platycercus*) as common ıke Tahoe in September.* This is quite out of the area of the known distribution at bird, which is distinctively a central region species. *Stellula*, on the other , is a common summer resident of this region and could scarcely have been over- d. It is not, however, mentioned by him from that locality. Hence I infer that ecimen of supposed *platycercus* was really the *Stellula*, more especially because he ırs to have been in doubt, and states that at first he supposed the species to be *S.* . In this latter supposition he may have been correct, but as, farther on, when ing of the Stellula as seen in the Cascade Mountains, he says he there mistook pecies for the young of *S. rufa*, we may presume his mistake to have been the same in both instances, and that the Lake Tahoe birds were the *Stellula*, as the Cascade Mountain birds proved to be. It is to be remarked that the young of several of the hummers are really so much alike, especially those of *calliope* and *rufus*, that a very careful comparison, which is rarely possible in the field, is necessary to distinguish them.

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* Birds of California, vol. 1, 1870, p. 357.

TROCHILUS Linnæus.

T. alexandri, Bourc. and Muls. Black-chinned Humming Bird.

This species appears to be a by no means common summer resident along the eastern slope, and to have there a limited distribution. It was observed and specimens were procured in June in Eastern California along Honey Lake. Farther north, in the mountains near Camp Bidwell, the species was present in July.

SELASPHORUS Swainson.

S. rufus, (Gmel.). Rufous-backed Humming Bird.

This hummer is probably rather local as a summer resident of the eastern slope. In the summer of 1876 I did not find it breeding in Eastern California, although plentiful enough there in fall. It appeared to be rather numerous in summer near Camp Bidwell.

ALCEDINIDÆ—Kingfishers.

CERYLE Boie.

C. alcyon (L.). Kingfisher.

Of common occurrence on all the fish-stocked streams.

PICIDÆ—Woodpeckers.

HYLOTOMUS Baird.

H. pileatus (L.). Pileated Woodpecker.

The "log cock" was not noted by our party at any point along the eastern slope, notwithstanding that the heavily timbered mountains would appear to favor its presence. On the Columbia, to the west of the divide, it was said by the lumbermen to be a numerous and constant resident. I shot a fine male, the only one seen, at the Cascades, in October.

PICUS Linnæus.

P. villosus harrisi (Aud.). Western Hairy Woodpecker.

Numerous as a resident of the pineries.

P. pubescens gairdneri (Aud.). Western Downy Woodpecker.

Along the eastern slope, as everywhere throughout the middle region, this is a rare species, and but a single individual was seen—in Chewaucan Valley, in August.

P. albolarvatus (Cass.). White-headed Woodpecker.

This woodpecker appeared to be less common everywhere along our route to the north than in the pineries immediately west of Carson. It occurs nevertheless here and there as a resident.

PICOIDES Lacépède.

P. arcticus (Sw.). Arctic Woodpecker.

A rather common and constant resident of the pine woods from Carson northward into Oregon.

SPHYRAPICUS Baird.

S. varius nuchalis (Bd.). Red-naped Woodpecker.

This middle region form extends across from the Rocky Mountains, and occurs in summer along the eastern slope. Beyond this we have no evidence of its presence, it being replaced upon the west coast by the following bird.

Mr. Ridgway alludes to the fact that in the region between the Rocky Mountains and the Cascade Range specimens of this form give evidence, by the admixture of red in the black auricular stripe, the black pectoral collar, and in the white area surrounding it, of the change soon to result in the variety *ruber*, in which these parts are red. Two males, however, taken in the Warner Mountains, Northern California, show no such tendency, but, on the contrary, are not distinguishable from Rocky Mountain specimens.

S. varius ruber (Gm.). Red-breasted Woodpecker.

Somewhat to my surprise I was able to obtain no evidence that this variety summers along the eastern slope, and am compelled to believe that it is only found here in the character of a fall and winter visitor.

S. thyroideus (Cass.). Brown-headed Woodpecker.

Of rather frequent occurrence all through the mountains.

ASYNDESMUS Coues.

A. torquatus (Wils.). Lewis Woodpecker.

Nowhere in its wide range is this species more abundant than at the base of the eastern slope, through Nevada, California, and Oregon. It was seen at The Dalles during the last of October, and according to Suckley it remains here during the winter.

COLAPTES Swainson.

C. auratus mexicanus (Sw.). Red-shafted Flicker.

An abundant and widely-distributed species. The birds of the eastern slope appear to be the typical *mexicanus*, and I have never seen a specimen from this region showing intermediate characters. In the Sacramento Valley and about San Francisco such specimens are comparatively common, and the manner and degree in which individuals assume the characters of either race vary indefinitely.

STRIGIDÆ—Owls.

STRIX Linnæus.

S. flammea americana (Aud.). American Barn Owl.

Though a very common inhabitant of California, especially in the southern portion, and extending, according to Cooper, as high as the Columbia River, this owl appears to confine its range, so far as this region is concerned, to the country west of the Sierras, and it does not appear in any of the sectional lists east of that range between Kansas on the east and Arizona on the south. That it does occur on the east side of the Sierras I obtained ample proof during the past season. Near the Madeline Plains in Eastern California I found scattered feathers of barn owls, indicating that they inhabited the thickets along the streams. At Camp Bidwell it seemed to be a tolerably common species, and on several occasions individuals were started up as they were roosting among the tangled willows. This was late in September. It also appears to be of at least occasional occurrence in Western Nevada, and Mr. H. G. Parker has information of the capture of a specimen or specimens near Carson.

It is one of the most strictly nocturnal of the family, and as its diurnal retreats are usually of the most inaccessible character, the bird readily eludes casual observation. Hence it is likely to prove to be more widely diffused in the interior province than we are at present aware.

OTUS Cuvier.

O. vulgaris wilsonianus (Less.). Long-eared Owl.

Numerous in the thickets of the lowlands, where it is resident throughout the year.

O. brachyotus (Stev.). Short-eared Owl.

This owl was found to be common in the sedgy marshes about Warner Lake, Oregon, and doubtless inhabits similar localities throughout Eastern California and Nevada.

BUBO Dumeril.

B. virginianus sub-arcticus (Sw.). Western Great Horned Owl.

Often heard in the mountains, where it is resident. Two individuals of the many seen were obtained in the Cascade Mountains. They represent the common interior type.

SPEOTYTO Gloger.

S. cunicularia hypogæa (Bp.). Burrowing Owl.

Numerous in all suitable localities through this region.

FALCONIDÆ—Hawks, Eagles, etc.

CIRCUS Lacépède.

C. cyaneus hudsonius (L.). Marsh Hawk.

Very numerous in every suitable locality.

ACCIPITER Bonaparte.

A. fuscus (Gm.). Sharp-shinned Hawk.

A single specimen only of this hawk was obtained, at the Columbia River, in October.

A. cooperi (Bon.). Cooper's Hawk.

Appears to be much more numerous in this region than the preceding. Seen on the Columbia in October.

ASTUR Jard. and Selby.

A. atricapillus (Wils.). American Goshawk.

This fine hawk was seen at several points along the Cascade Mountains in Oregon, where it, without doubt, breeds.

I had very little chance to observe its habits; probably they do not differ essentially from those of its smaller relatives. One that I shot on the Williamson's River was in hot chase of a kingfisher, which he doubtless would have seized in another moment. Another, on the same river, was noticed chasing a night heron. The attack was persistently kept up, but evidently with no intention on the part of the hawk of making the heron his prey. Forcing the heavy-winged heron into the open, the hawk would close in and apparently give the ungainly bird a buffet with his wing, which each time produced a loud and discontented squawk. It occurred to me, as a possible solution of the motive of the hawk, that he intended to force his victim to throw up any fish it might have secured, and so furnish him an easy dinner.

FALCO Linnæus.

F. lanarius polyagrus (Cass.). Prairie Falcon.

A widely-diffused species, and common in certain localities of this region, as near Camp Bidwell.

In the fall its habits as truly entitle it to the appellation of "duck hawk" as its relative the *F. anatum*. The latter, although not falling under our observation, certainly occurs in this region, but by no means as commonly as its ally.

F. richardsoni. Richardson's Falcon.

The presence of this falcon was noted in several localities in Oregon and Northern California, and two specimens in immature plumage were taken.

F. sparverius (L.). Sparrow-Hawk.

Very common throughout this whole region.

The west side of Chewaucan Valley had suffered severely from a visitation of that scourge of the western farmer, the grasshoppers. Here in August the sparrow-hawks had assembled in hundreds and were holding high carnival, and although in instances like the present their numbers prove wholly insufficient to cope against the vast myriads of these destructive insects, yet the work of the sparrow-hawk is by no means so insignificant that it should not be remembered to his credit and earn him well-merited protection. His food consists almost entirely of grasshoppers when they are to be had, and as his appetite appears never to become satiated, the aggregate in numbers which are annually destroyed by him must be enormous.

BUTEO Cuvier.

B. swainsoni (Bp.). Swainson's Hawk.

Very numerous in summer in the low partially-wooded country near the mountains. I noticed more of these hawks in Northern California than farther south, but this ine in numbers may have been only apparent, and due to their concentration as fall ached.

realis calurus (Cass.). Western Red-tailed Hawk.
merous throughout all the heavily-wooded portions of the region.

ARCHIBUTEO Brehm.

rugineus (Licht.). California Squirrel Hawk.
awk was seen in Northeastern California which I believed to be of this species.

gopus sanctijohannis (Gmel.). Rough-legged Hawk.
nmon in fall in marshy localities.

AQUILA Brisson.

rysaëtos canadensis (L.). Golden Eagle.
curring more or less numerously among the mountains.

HALIAËTUS Savigne.

ucocephalus (L.). American Eagle.

is eagle may fairly be said to abound on certain of the mountain lakes of this re- Eagle Lake indeed receiving its name from the number of these birds that in- its shores. Rarely disturbed, they are much less shy than usual, evidence of act being apparent in the accessible situations which their nests occupy. Sev- vere noticed in the splintered tops of pines, the low heights and convenient hes of which placed them within easy reach.

e nest that I visited as late as July 10 contained two young, still unable to fly, gh in size fully grown.

ng the Columbia, eagles are so common that they scarcely attract attention. they are useful as scavengers, and dead and dying salmon form a very consider- portion of their fare.

PANDION Savigne.

liaëtus carolinensis (Gmel.). Fish Hawk.
sent on nearly all the streams and lakes that furnish fish. Extremely abundant amath Lake.

CATHARTIDÆ—American Vultures.

RHINOGRYPHUS Ridgw.

ra (L.). Red-headed Vulture.

erally distributed; in some localities, as near Honey Lake, California, very numer- Not seen at the Columbia River in October. Nor was the Californian vulture *dogryphus californianus*) observed along the river, although, judging from the ac- s of Cooper and Suckley, it formerly periodically visited its shores, attracted er by the dead salmon, which, during the "run," often line the banks. The ac- s of these authors date back to 1854, and since that time the numbers of this huge re have been so diminished by the use of poison, intended to kill off wild animals, it is now in comparison almost extinct, and the sight of a California vulture is at nt a rare event in localities where a few years ago it was very numerous.

COLUMBIDÆ—Doves.

ZENAIDURA Bonaparte.

olinensis (L.). Turtle Dove.

iving in the vicinity of Carson about the 1st of May, the "doves" soon become mely numerous, not only here but all along the eastern slope, far up into Oregon Vashington Territory.

the game law of Nevada this species is exempt from protection at any and all ns, and as it is about the only bird here that affords wing-shooting, it hence, in eighborhood of the towns, receives considerable attention at the hands of the ers, especially during the early portion of its visit in spring.

It begins to nest about the middle of May, and then its persecution perforce ceases, since it no longer resorts to the stubble-fields and pastures for food, but, having paired, retires to the hills, where it is out of reach.

The numbers killed, although in some sections very great, appear to have no visible effect in diminishing its abundance.

It migrates south early, and but few are to be found in Nevada by the end of August. As late as the 23d of September I noticed a few young birds, probably the late second broods, still lingering about the stubble along Crooked River, Oregon.

COLUMBA Linnæus.

C. fasciata (Say). Band-tailed Pigeon.

At The Dalles I caught a glimpse of a solitary individual which I identified as this species. It is said by both Cooper and Suckley to be abundant to the west of the mountains, and doubtless wanders across the range with greater or less frequency, the abundance or scarcity of food, especially acorns, having much to do in determining its presence or absence in a region. Dr. Newberry speaks of it as occurring at The Dalles in fall.

TETRAONIDÆ—Grouse.

CANACE Bonaparte.

C. obscurus (Say). Dusky Grouse.

The "blue grouse," which is found in the Sierra and Cascade Ranges, at least along their eastern slopes and as high up as the Columbia River, is the typical middle region form, *obscurus*.

The mountain forests, especially those composed largely of firs and spruces, abound with this fine game-bird. Several broods of young chicks were found about the middle of June.

First plumage of young.—Feathers of the back and wings (except primaries) with broad central line of white, and marked transversely with spots and bars of black and rufous brown; throat and belly brownish white; breast and sides of body profusely maculated with black.

CENTROCERCUS Swainson.

C. urophasianus (Bp.). Sage Hen.

Numerous as is this species in many portions of the Rocky Mountain region, it appears to be even more abundant in the sterile tracts that lie just east of the Sierra Nevada and Cascade Ranges, where it is generally diffused in all suitable localities from a point well up towards our northern boundaries to as far south as the Mojave River where reported by Cooper. The most southern point at which the bird was encountered by our parties was about fifty miles south of Carson, as indicated by Lieutenant Macomb. Somewhat to the north of here it begins to be very numerous, and in certain localities, as near old Camp Warner, Oregon, its numbers are simply astonishing. A day's ride through this section in almost any direction will reveal band after band, many containing numerous individuals.

During the summer it inhabits preferably the low mountains and hills, which are only saved from utter barrenness and destitution by a growth of sage or brush of similar kind and a scanty covering of coarse grass. The little valleys intervening contain occasional springs, which with the surrounding plats of green verdure form little oases, and these are the centers around which congregate, at least thrice a day, all the sage-hens within a considerable area. When making the usual night's camp we have often started up fifty or more of these big grouse almost within stone's throw of the solitary pool of water. At midday, too, flocks of old and young love to come in from the sterile tracts where they have been feeding, to drink and bathe and repose in the grateful shade which they find only in such spots.

After the young are able to run about, I believe the mother bird assumes sole charge over them, and that the old cocks assemble into bands and remain by themselves. I have on several occasions seen a dozen or more old males, lean in flesh and with plumage soiled and worn, thus associated. The old cock, under such circumstances, is a wary bird and knows well how to take care of himself. Little need, however, has he of his caution, since his toughness and general unsavoriness will be likely to cause anyone who once has made his acquaintance on the table to give him a wide berth in the future. But it is some time ere the young learn fully the necessary lesson of caution and self-dependence, and even after they have become almost fully grown they may frequently be put up one by one and killed without causing the dispersion of the rest of the band.

In fact, the tameness of the sage hen when, say, two-thirds grown, is occasionally so remarkable as to appear scarcely credible. As an instance, I remember on one occasion, when in one of the wilder districts of Oregon, pointing out a pair to a comrade, who had expressed a desire to try a shot on the wing at this, to him, new game. Unscreened by cover, the pair permitted him to approach within a dozen feet or so, regarding with mild wonder his demonstrative motions, and even failing to take alarm when dirt and pebbles were tossed at them. With the remark that they were too slow game for him, my disgusted friend left them to resume their picking among the herbage, which they did while we were still regarding them.

During the months of June, July, and August the young are very tender, and, if properly attended to by being drawn as soon as shot, are fair eating, but this is the limit of praise that my taste, at least, will permit me to bestow.

PEDIŒCETES Elliott.

P. phasianellus columbianus (Ord). Southern Sharp-tailed Grouse.

This grouse appears to be entirely absent from Eastern California and Western Nevada, except in the upper districts. About Camp Bidwell, Cal., the "sharp-tails" are sufficiently numerous to afford excellent shooting, and good bags may be made there. Farther north in Oregon, and especially on the grassy plateaus that border the Columbia River and on the rolling hills for a hundred miles south, it is extremely abundant. Most of this section is quite uncultivated, and the grouse live among the dry hills and get fat upon their natural food of seeds, berries, and insects. They descend regularly into the valleys, as well to get water as to roost in the brush at night. A stubble-field of wheat is sure to attract them in great numbers, especially towards fall, and they seem to prefer this fare to aught else.

I have never had any experience in the field with the true prairie chicken (*C. cupido*), but, judging from the written accounts, the general habits of the two birds are extremely similar.

BONASA Stephens.

B. umbellus sabinii (Dougl.). Red Ruffed Grouse.

This form of the ruffed grouse occurs abundantly along the eastern slope, although perhaps not until Oregon is entered. At least, Fort Klamath was the first point at which I obtained undeniable proof of its presence.

It may here be remarked that the grouse of this region, while referable as above, do not typically represent the variety *sabinii*, which reaches its maximum of development, as indicated by depth of color and redness of tint, only on the Pacific slope.

In the dense coniferous forests that border the Columbia, as it passes through the Cascade Mountains, these grouse are found in very great abundance, the almost impenetrable undergrowth of deciduous bushes, with their nutritious fare of buds and berries, greatly favoring its presence, as offering both food and cover.

It is scarcely necessary to add any details respecting the habits of this bird; for in this remote region it appears the exact counterpart of the familiar partridge of New England. True, they are here very tame and almost devoid of fear of man; so tame are they, in fact, that without a dog it is well nigh useless to attempt their pursuit. Provided with almost any sort of a cur that will run through the bushes and bark when the birds wing their way to the nearest tree, which they will invariably do when started, almost any desired number may be potted; for "pot hunting" it is, and nothing else.

Much the same statement may be made of the conduct of the ruffed grouse in the more remote New England districts, as in some unfrequented parts of Maine; so, with a statement of general conformity of habits, the subject may be left.

PERDICIDÆ—Quails.

OREORTYX Baird.

O. pictus (Dougl.). Mountain Quail.

Judging from the personal field experience of the past three seasons, this fine game-bird is much more numerous within an area of twenty-five miles of Carson than anywhere to the northward. In fact, it is only at rare intervals that it appears to cross the mountains and appear along the eastern slope. Evidence upon this point is not so full as could be desired, since its introduction at the hands of man at certain points renders the question of its natural distribution in this region a difficult one to determine. In general, it is safe to say that the places where they have reached and maintained a residence along this slope are very few. Nevertheless, about Carson, at Eagle and Honey Lakes, Cal., and at The Dalles, on the Columbia, their presence was detected, and is to be accounted for through the natural dispersion of the species. Elsewhere as at several localities near Camp Bidwell, Cal., the several covies are the descendants of birds brought from the Pacific slope and let loose to shift for themselves. They are nowhere in this region very numerous.

Desription of first plumage of young.—Prevailing color of the head, neck, back and breast grayish olive, more plumbeous beneath, and everywhere more or less sprinkled with white; the markings on the breast larger and of more regularly deltoid form; chin, whitish; throat and cheeks mixed with dark plumbeous, a dusky auricular patch with an indistinct whitish line just above. Crest, 1¼ inches long; black, with tips irregularly marked with zigzag lines of pale fulvous. Scapulars, wing-coverts, tertials, and rectrices pale brownish, finely vermiculated with dusky. Abdomen whitish; flanks marked with chestnut and white; bill blackish; feet pale brown.

LOPHORTYX Bonaparte.

L. californicus (Shaw). **California Valley Quail.**

This quail is nowhere indigenous along the eastern slope, as the high mountains offer a complete barrier to its extension. Those introduced about Carson appear to just hold their own.

CHARADRIIDÆ—Plovers.

ÆGIALITIS Boie.

A. vociferus (L.). **Killdeer Plover.**

An abundant summer inhabitant of this whole region, the mountains excepted. Nests on the marshy borders of all the lakes. Numerous fresh eggs were found at Washoe Lake, Nevada, May 30.

RECURVIROSTRIDÆ—Stilts, Avocets.

RECURVIROSTRA Linnæus.

R. americana (Gmel.). **American Avocet.**

Our knowledge of the range of this species over the United States is so full and complete that little remains to be added. Except immediately upon the Pacific coast, where it is found in comparatively small numbers, no portion of the Rocky Mountains and the region to the westward has been entered by our parties without finding this bird, at the proper season and in suitable localities, abundant.

During the migrations its distribution in the West is extremely general, and its presence is to be expected along all of the streams, ponds, and lakes, except, perhaps, in the highest mountainous districts, from the Mississippi to the Pacific.

In the breeding season its range is scarcely less restricted, and those sections only are exempt from its visits that lack the necessary requisites to its mode of life at this period.

In the neighborhood of Washoe Lake, Nevada, it is especially numerous, and here, about the middle of May, I found the birds paired, while some, at least, were building. They were first noticed on some small ponds near the shores of the lake, a locality quite typical of their choice at this season. The muddy flats of such little inlets always prove more attractive to birds of their habits than larger bodies of water, inasmuch as the shallows permit them to wade about with perfect freedom; while food, which in summer consists very largely of the larvæ of aquatic insects, is more abundant in these tepid waters, as well as more readily obtained. I have sometimes thought that *alkaline* marshes and ponds were really preferred by these birds, attributing this choice to the possible fact of the greater abundance of the larvæ alluded to in such. Be this as it may, the fact that water happens to be extremely brackish and alkaline is at least no drawback to the avocets.

While the avocets are waders in the fullest meaning of the term, they are also adept swimmers when choice or necessity calls; but of this accomplishment, so far as my observations go, they rarely when unmolested avail themselves. I remember on one occasion to have seen a wing-tipped avocet trust itself pluckily to the waters of a broad lake and swim steadily out, though in the face of a gale that I should have thought a duck could scarcely have stemmed; since which time I have always entertained a high opinion of the natatorial powers of this species, although, as remarked before, they are usually held in abeyance.

On the occasion of my first visit to the place mentioned above, I found the birds, with now and then a stilt, in considerable force, and so great was their solicitude at my intrusion and so vehement their outcries, that I took it for granted I was in immediate proximity to their nests. My search proving of no avail, I accepted without hesitancy the apparent fact that I had anticipated by a few days their nesting-time; and it was not until June 1 that I learned the full extent of the deception that the wily birds had practiced upon me.

While collecting at that date in a very similar locality half a mile or more up the lake, I found myself possessed of their secret, and in the midst of a large colony of both avocets and stilts, while numbers of the nests of either bird rewarded an easy search. As was plainly to be seen, it was their foraging trips that carried them away from home to the place where I had at first encountered them. Even at this remote point, their anxiety, real or pretended, had enabled them to effectually blind me as to the actual situation of their breeding-ground.

If the outcries of the few had been noticeable before, the confusion of sound resulting from the combined numbers of the whole colony was simply bewildering. The unfortunate pair whose nest I first stumbled upon used all the artifices common to birds in such a strait to entice me away. They would run furtively about a few yards distant, and then squat close down to the ground, and grovel in the loose earth as if settling over their eggs, while they kept uttering subdued coaxing notes as though calling to imaginary young. Their efforts at simulating the actions of wounded birds, which was the evident significance of the drooping wings and staggering gait adopted, were not very successful, and the nature of the deception was too apparent to deceive even a novice. After a while they appeared to become convinced of the futility of these attempts, and then rage took the place of sorrow. Flying about me in wide circles, the various pairs screamed and scolded till apparently exhausted by the excess of their emotions, when they betook themselves to a safe distance. I could not help fancying that the amount of sympathy extended the bereft birds by their neighbors was in pretty exact ratio to the proximity of their own nests, those pairs being the most venturesome and vehement whose own danger appeared greatest, while away on the verge of the marsh stood quietly or fed leisurely about, in fancied security, those couples whose distant homes seemed not to be threatened.

In placing its nest the avocet shows a certain degree of cunning, and for this purpose usually avails itself of some little islet or isolated strip of marshy ground where its eggs and young are comparatively removed from the danger of intrusive visits from all four-footed prowlers. One enemy they have from which this situation offers no protection. I refer to the inland gull of this region, the *Larus californicus*. Gulls, as is well known, are very fond of eggs, and never allow a chance of robbing other birds to pass by unimproved. In the present instance the outcries of the abused avocets had attracted the attention of a flock of the above birds that had been hovering over the lake, and, apparently scenting their opportunity, they swept in on poised wings or moved in gentle circles, awaited a favorable moment to descend to the feast.

That both avocets and stilts were well aware of the proclivity of these new foes was soon apparent. For when one of the gulls, becoming, perhaps, impatient, flew in close to the nests, all the birds near, forgetting on the instant their human enemy, combined to repel this fresh assault. Gaining a vantage ground above the big birds, they pounced down, striking their foes with wings and bills, until the gulls were forced to a hasty and ignominious retreat. These attacks and counter-attacks were repeated several times, until the gulls, discomfited by their warm reception, left the vicinity.

The eggs are laid in plain view, and are quite unprotected by grasses or other screening. The slight hollow, scratched and patted down in the damp soil to receive them, is occasionally quite thoroughly lined, oftener very slightly, with bits of weeds, stalks, &c. The number of eggs varies from two to four.

HIMANTOPUS Brisson.

***H.** nigricollis* (Vieill.). Black-neck Stilt.

The mode of life of the stilt is, in all important particulars, like that of the avocet, and so invariably have the two birds been associated when under my notice, especially at the breeding period, that anything which brings to mind the one species is sure to recall the other. This companionship is a purely accidental one, arising from an independent choice of the same localities, under the promptings of similar tastes as to food and other necessities. Both are waders par excellence. But if the stilt ever swims at all, and it doubtless possesses this power to a certain extent in common, I believe, with each and every member of its long-legged fraternity, it must be only in extreme emergencies. I have myself never seen it take to the water under any circumstances. In many other minor particulars of habits and actions the two birds differ.

In the West one may expect to find the nests of the stilts alternating at short distances with those of the avocets, as if the two were unconscious or at least indifferent to each other's presence. Indeed, in many instances it would be no easy task to satisfactorily identify the eggs of the two species in the rabble of parent birds that hover around the intruder, were it not for the fact that the very considerable difference of size in the birds is exemplified in the eggs, those of the stilt being very perceptibly the smaller, corresponding with its more slender and everyway less bulky body.

When a colony of the two species is disturbed, they seem to vie with each other in the importunity of their attempts to mislead the intruder. Thus it often happens that the egg collector will find himself at his wit's end to determine the precise ownership of a clutch of eggs before him in the dozen or more stilts and avocets which are flying about. He has only to exercise a little patience and remain quiet until the excitement of the birds has had time to abate somewhat, when pair by pair the strangers will drop away till one or two only are left. From these he will soon be able to pick out the owners of the particular nest by their more persistent and manifestly greater solicitude.

The young of both species leave the nest almost immediately upon being hatched, and I have several times found them in a condition so weak and helpless that they seemed scarcely able to stand, much less walk; suggesting indeed, by their helplessness, the possibility of their having been removed from the nest by the parent birds upon the first sign of danger.

PHALAROPODIDÆ, Phalaropes.

STEGANOPUS Vieillot.

S. wilsoni (Sab.). Wilson's Phalarope.

Of the three species of phalaropes the present is much the best known, probably because of its very general diffusion throughout the interior, and because it breeds abundantly with us.

In the region in question it has been found to be plentiful, both as a spring and fall migrant and as a summer resident.

This phalarope was first noticed about Washoe Lake, Nevada, May 17, and the first arrivals from the south probably occur early in this month. By the 23d many had paired, and much anxiety was manifested when I approached certain localities in the marsh, where, however, I could find no nests. At this date they were probably just about ready to lay, and a female, when dissected, was found to contain a well-developed egg.

For nesting purposes this bird appears always to prefer the borders of little pools, and the grassy, boggy edges of prairie sloughs, to the neighborhood of large bodies of water; and in this region one rarely approaches a locality of the nature of those first mentioned without being met by one or more pairs of phalaropes, that come flying to meet the visitor with subdued and solicitous notes that clearly betray their anxiety to learn the character of his errand.

As their nests and eggs have often been described, they need not be touched upon here.

LOBIPES Cuvier.

L. hyperboreus (L.). Northern Phalarope.

Of more common occurrence upon either coast, this phalarope is yet occasionally found in our interior during both the spring and fall migrations. Thus the last week of May the little ponds and inlets about Washoe Lake were found to contain numerous flocks, large and small, all which seemed to be in the greatest possible haste to reach points unknown farther to the north.

The little phalarope unites in itself the characteristics of several families, and seems, as it were, a sort of connecting link between them. Thus in it appear the general outlines and trimness of form that distinguish the sandpipers, joined to a plumage much like a duck's, while the lobing of the feet appears to be modeled after the plan of the coot's. Its habits express these peculiarities of structure very nicely, for in nimbleness it simulates the sandpipers, if, indeed, it does not surpass them; while very few of the latter can compare with the lobe-foot in grace and elegance. Added to these qualities, its natatorial powers, when are taken into account its diminutive size and pigmy strength, are really of first-class order.

It is difficult to imagine a more beautiful sight than that presented by a flock of these phalaropes as in their brightly-colored nuptial dress they pass with graceful action along the shallows in search of food. In some respects their movements when thus engaged are peculiar and quite unlike those of any other bird with which I am acquainted. The flocks I saw kept closely together, and in a compact body moved hastily along, each bird gleaning the ground as he advanced by a continuous movement from side to side, the body being turned quickly, as on a pivot, and the bill lowered into the water with a quick thrust. This action gave each bird the appearance of describing at every movement a full half circle, while the motions of the whole flock were so constant, rapid, and uniform that they resembled more the actions of a living machine moved by one impulse than a flock of individual birds actuated by separate wills. In the manner described they passed in a very few moments over considerable space, and I think it likely that these flocks were actually migrating at the time; at all events, the course maintained by them, as long as they were under notice, was a due northerly one.

Like most other species whose "make-up" enables them them to swim and wade with equal facility, our phalarope prefers the latter, and when feeding quietly only avails itself of swimming when it encounters some deep channel that interferes with progress. Or, again, when disturbed by too close scrutiny, they take to the water with an assurance that indicates it is no novelty to them. Thus they frequently became alarmed under my espionage and swam to the midst of the pond, and, having put between us what they considered a safe distance, gathered quietly in a compact circle and awaited further developments with an air of wonder and innocent expectation that was very amusing, as well, too, as touching in its utter unsophistication.

This species attains a nearly full development of the nuptial plumage within our limits, as was evidenced by the birds referred to here.

The females, as in case of the other two species, are much the brightest of the sexes, and the most highly colored male hardly equals the dullest female.

Upon dissection, evidence appeared of strong sexual excitement in both sexes, and I am inclined to believe that this phalarope will yet be found to breed along our northern frontier, possibly even in the mountains of Oregon. In fact, Dr. Cooper speaks of having seen a pair of either this species or the red phalarope in the Cascade Mountains of Washington Territory in August, which he thought were probably breeding. The latter species has never fallen under my observation in the West, and it is chiefly maritime.

SCOLOPACIDÆ—Snipe.

GALLINAGO Leach.

G. wilsoni (Temm.). Wilson's Snipe.

Although the range of the Wilson's snipe during the migrations covers the United States from ocean to ocean, its breeding limits are much more circumscribed, being chiefly along and beyond our northern borders. But in many of the mountainous sections of the far West it finds a climate and conditions well adapted to its needs, and here it passes the summer at a somewhat lower latitude than in the East. In Oregon, as also throughout all that portion of Eastern California and Western Nevada to the north of the line of the railroad, the Wilson's snipe may be confidently looked for in summer in all the little mountain meadows and along such alpine streams as by virtue of their overflow are bordered by the soft, oozy spots which are so indispensable to its habits. As often as otherwise these tracts occur among pine timber at quite elevated altitudes.

I first became aware of its presence in Nevada June 15. At this date, while making camp just at dusk near a small stream at the base of the mountains, I heard for the first time the peculiar sounds which are made by this snipe during the excitement of the love season, and I confess that at first I was not a little puzzled to explain their authorship. Afterwards I had several opportunities to observe the birds in the very act of producing them. The first impression received, shared in, too, by other members of the party as the sounds were borne to the ear from a distance, was that they were the notes of one of the small owls, muffled and disguised by reason of the remoteness of the bird. As the snipe flew nearer, and particularly as it passed directly overhead, the nature of the sound became more apparent, it then being comparable, as closely as anything I could think of, to the whistling noise which is so marked a peculiarity in the flight of the common dove (*Zenaidura*). This was the comparison that was suggested to all the party at the time, although it fails to give a very precise idea of its peculiar character. Mr. Ridgway hearing the snipe from a distance likens it to the "noise produced by water escaping from a nearly full jug," it having "a hollow, gurgling sound." However observers may differ in interpreting its peculiarities, no one, I think, who hears under favorable circumstances the sound we have attempted to describe, is likely to agree with Nuttall in his supposition that the sound proceeds from the bird's throat. It is unquestionably due to the wings alone.

The *modus operandi* is somewhat as follows: Mounting high in air the bird flies rapidly and excitedly back and forth, and at intervals of every moment or two, and while at full speed, the head is lowered, the wings bent and stiffened, and a downward plunge made at an abrupt angle, which terminates suddenly with a sharp ascent; and it is at the moment that the downward is changed to the upward flight that the sound is produced. To make such an extremely abrupt change in the line of flight possible, the wings must be bent into an unusual shape, and by reason of their action upon the air comes the whistling sound.

During the mating, and in fact through most of the breeding period, and continuing even after the young are hatched, the birds begin these evolutions as soon as dusk comes on, and continue them at irregular intervals until about nine o'clock. The notes are not heard again till about daybreak, and they cease before sun-up. But should the day be cloudy the snipe may be seen flying in the manner described till late in the morning, often indeed till nearly noon. I think that the males alone are concerned in the production of these odd notes; but of this I am not sure. The sexes have a harsh call-note in common which they utter as they fly casually about, which may be expressed by the syllables kâ-kâ-kâ-kâ; thus very different from the "musical" scaip-scaip, so familiar to every sportsman.

Other evidence is not wanting to show that our long-billed friend of skulking proclivities allows the events of the love season to quite turn his head, and various are the idiosyncrasies that take the place of his usual staid habits. One need not, then, be surprised upon putting him up in summer to find him alighting on a tree or fence-rail, and, so perched, to stand for long intervals as though rapt in deep meditation.

In the region in question the snipe apparently begins to nest some time in May, and by the middle of June I found young not fully divested of the down.

Several nests were found with the cracked egg-shells lying immediately about. They are usually built on a tussock of grass, if indeed the term building is applicable to the slight structure made by bending down a few grass blades and adding a few bits of withered herbage.

TRINGA Linnæus.

T. minutilla Vieill. Least Sandpiper.

Common during the migrations.

EREUNETES Illiger.

E. pusillus (L.). Semipalmated Sandpiper.

As preceding.

TOTANUS Bechstein.

T. semipalmatus (Gmel.). Willet.

Present about Washoe Lake in May, where it probably breeds, as it certainly does in many similar localities to the northward.

T. melanoleucus (Gmel.). Greater Yellow Legs.

Numerous as a migrant. Flocks of this species were seen on their way south as early as July 27.

TRINGOIDES Bonaparte.

T. macularius (L.). Spotted Sandpiper.

A summer visitant throughout this region, although not very numerous.

NUMENIUS Linnæus.

N. longirostris (Wils.). Long-billed Curlew.

Numerous as a summer resident along the marshy borders of the large lakes, but most abundant during the fall migrations. In August the stubble-fields near Goose Lake were fairly dotted with these birds, busily at work hunting grasshoppers.

TANTALIDÆ—Ibises.

PLEGADIS Kaup.

P. guaranna (L.). Bronzed Ibis.

This ibis has an extensive range in the west, it finding place as occurring at one season or another in nearly all the local lists of the country west of the Mississippi River. It reaches to the north as far as Southern Oregon, where it breeds. As the species was not found by Bendire about Camp Harney we may perhaps assume that the above is about its northern limit. Nowhere is it more abundant than in the region from the line of the railroad to Northern California and Nevada, being there found in summer as an inhabitant of the tulle swamps on all the lakes large and small, except in the high mountains.

Its general habits are much like those of the herons, and the marsh and slough are not more essential to the mode of life of the latter birds than of the glossy ibis. During the migrations, it is true, flocks of ibises may be seen feeding in plain view in the open shallows along shore, but it is quite exceptional to find them in such situations during the breeding season. Apart from their habit of nesting among the rushes they seem to prefer the secrecy and solitude conferred on them by the sheltering reeds, and if the marsh be treacherous and oozy so much the better is it likely to prove for their special purposes as favoring complete isolation. While duck-shooting the report of my gun has frequently started up a dozen or more of these ibises, that sprung with hoarse croakings from little muddy pools and recesses almost within stone's-throw, where, screened upon all sides, they had been quietly feeding without conveying a hint of their presence.

Inherent in the nature of the ibis there is a certain wariness which to some extent makes amends for its natural stupidity. For, to few birds does the term stupid apply with more force than to the present species. The very "make-up" of the bird is suggestive of a sluggish disposition, there being evident a certain ungainliness of form that it is impossible to associate with keen intellectual activity, and that is the very reverse of what is implied by the alert actions and elegant appearance of its allies, the herons. Doubtless the long, heavy bill and slender neck surmounting its thickset body contribute much to its uncouth appearance, and convey an impression which the really beautiful plumage serves only partially to dispel. However, the ibis may safely claim that, even if its appearance is not in all respects pleasing to the eye, its ensemble has at least the beauty of utility, and its stout legs and long toes and claws, its heavy, curved bill and long neck all serve most admirably the purpose intended, which is, after all, the chief consideration.

By the 20th of May the ibises all appeared to be paired about Washoe Lake, although neither then nor a week later was I able to find their nests. Perhaps this was a little early for the deposition of the eggs, although the oviduct of a female shot June 3 contained a perfect egg.

ARDEIDÆ—Herons.

Ardea Linnæus.

A. herodias L. Great Blue Heron.

A common summer inhabitant of this whole region.

Herodias Boie.

H. egretta (Gm.). Great White Egret.

Colonies of this species reside in summer on many of the lakes which lie at the foot of the mountains in Eastern California and Western Nevada, while we learn from Captain Bendire of an extensive heronry as high to the north as Lake Malheur, Oregon.

Warner Lake, just within the southern borders of that Territory, forms a favorite resort for several species of the heron family. The white egret unites with the others to form colonies that build their nests in the larger growth of willows along shore.

Visiting such a heronry in September I found a dozen or more of the partially fledged young swinging by the necks from the crooked branches where they had evidently fallen as they clambered about the nests, and perishing miserably had hung till converted into mummies by the dry winds.

Garzetta Kaup.

G. candidissima (Jacquin.). Little White Egret.

Observed at several localities in Nevada and Eastern California where it is not so common as the preceding.

Nyctiardea Swainson.

N. grisea nævia (Bodd.). Night Heron.

Perhaps the most abundant of the family, and present in all the marshes.

Botaurus Stephens.

B. minor (Gm.). Bittern.

A common summer visitant as far north as Southern Oregon, reaching perhaps into Washington Territory as it does to Puget Sound on the coast. (Cooper.)

GRUIDÆ—Cranes.

Grus Linnæus.

G. canadensis (L.). Sandhill Crane.

These large birds are numerous in so many portions of Nevada, California, and Oregon that it is scarcely worth while to particularize localities.

They breed in many of the sub-alpine valleys, where are found meadows of sufficient extent to afford both food and protection, and to these and the tule swamps they mainly limit themselves and the young till the latter are able to shift for themselves. In some localities where such resorts are not available, an occasional pair of old birds may be seen accompanied by a young one or two feeding on the grassy plain or open stretches of valley, where plenty of food is found in the shape of grasshoppers. Let once an Indian catch sight of one of these families and he makes short work of the young birds, which are readily secured from horseback, or even run down afoot.

Towards fall the cranes become more numerous, or, at least, more conspicuous, and in the region mentioned form a part of everyday scene, as in small companies they feed about in open view or fly in long lines from one valley to another, uttering their indescribably odd notes.

I know of no other bird that carries its instinct of caution to so great an extent as does the crane; and he must be careful indeed or greatly favored by fortune who obtains a shot at one.

The crane is usually held to be delectable fare; but my own experiments upon them, as served up in camp style, have not been entirely satisfactory, and I have found them tough and somewhat too gamey to bear the test of even a mountain appetite.

RALLIDÆ—Rails.

PORZANA Vieillot.

P. carolina, Cab. Carolina Rail.

Found throughout the summer, but apparently not so common as the succeeding species.

RALLUS Linnæus.

R. virginianus (L.). Virginia Rail.

Numerous about all the marshy lakes.

FULICA Linnæus.

F. americana (Gm.). Coot.

An extremely abundant summer resident of all the lakes, large and small, of this region.

They begin to build, about Washoe Lake, Nevada, the middle of May, at which date but few eggs had been laid, the majority of the pairs being still engaged upon their nests.

Their nests and nesting habits are too well known to need description here. A clutch consists of from seven to twelve eggs. The latter number, however, is very exceptional, nine being perhaps the average nestfull.

ANATIDÆ—Ducks, Geese.

CYGNUS Linnæus.

C. americanus, Sharpless. Whistling Swan.

The swans are among the latest migrants from the north, and hence come too late to fall under observation of our field parties.

With the approach of cold weather they occur in most or all the large lakes of this region, as well also upon many of the large streams.

It is certain that the above species occurs as stated, and, in all likelihood, the *C. buccinator* is also found at the same time.

ANSER Linnæus.

A. gambeli (Hartl.). Speckle-bellied Goose.

Towards the last of August in Northern California this species began to arrive from the north in considerable numbers. It becomes very abundant at a somewhat later date.

A. hyperboreus, Pall. Snow Goose.

Arrives rather later than the preceding, and perhaps in rather fewer numbers.

The Chen (*Chen Rossi*) has been found by Captain Bendire at Malheur Lake, Oregon, and in all probability is of regular occurrence as a migrant on the interior chain of lakes. The past winter (1878-'79) it has been exceptionally numerous in the Sacramento Valley and along the coast.

BRANTA Scopoli.

B. canadensis (L.). Canada Goose.

The extensive lakes of Western Nevada, Eastern California, and Oregon, afford summer haunts for many of the Canada geese, or honkers, as they are popularly called, to distinguish them from the smaller Hutchins' goose and the "speckle bellies," neither of which birds remain in summer within our boundaries.

The nesting season of the Canada goose is well nigh over ere others of the feathered tribe, save perhaps some of the *Raptores*, are thinking of beginning, and the deposition of the eggs takes place in this region as early as February. Their mode of nesting is various. At Pyramid Lake the islands are extremely rocky, and here the geese build either under bushes along shore or resort to spaces underneath overhanging cliffs, or even to hollows in the rocks that form slight caves. Another and perhaps the most usual location for the nest is on the sandy spits of islands. The wariness which characterizes this goose, as to a less extent the other members of the family, undergoes no relaxation at this season, but, if anything, is increased. The spot selected to receive the eggs must be secure from all chance of intrusion—hence their partiality for islands; and as soon as the young are able to take to the water they are guided to some safe feeding ground, usually in the shallow water along some solitary shore. This care is rendered the more necessary, inasmuch as a long period must elapse for the young to receive their full powers, and they obtain nearly the size of the old birds ere their pinions are sufficiently developed to raise them from the water. Not infrequently, when riding along the rarely-visited shores of the lakes in the remoter districts, our parties have come suddenly upon these families of half-grown goslings, but rarely indeed ere the watchful parent had caught the alarm and had urged her convoy to a safe distance from the shore. Their food is now obtained wholly from the water, and not until the young have passed quite out of the gosling stage and have become fully developed in every respect do old and young assemble into flocks or "gaggles," and their visits to the stubble fields and pastures begin.

The birds that breed in this region start southward at a period nearly coincident with or a little before the arrival of the full flocks from more northern grounds. Just prior to setting out they are in the best condition, being fat and juicy from their mingled fare of grain and tender grass shoots.

ANAS Linnæus.

A. boschas (L.). Mallard.

One of the best known, as also one of the most highly esteemed, of all our ducks, its extensive range and great abundance wherever found, entitles the mallard to a place in the front rank of our valuable food-birds. In the West, as a table bird, it takes precedence, I think, of all others, its very general habit there of feeding upon grain for a part of the year conducing to its excellence of flavor.

In the region our report covers it is very numerous, not only during the migrations, but also in summer, when large numbers remain to breed about the various lakes. For this purpose it resorts to precisely the same localities as the red-breasted teal, viz, the partially submerged marshes; although, in truth, but little change of locality is in case of either of these birds necessary, since their tastes lead to the choice of similar places all the year round. So much alike, in fact, are their habits of nidification that during a day's hunt I have found many nests of the mallard alternating with those of the teal, and in many instances the nests of the two were but a few feet apart.

The mallard begins to lay during the last days of April and the early part of May, and by the 23d of the latter month I found several nests in which the eggs were far advanced, while in one the ducklings had appeared.

The mallards place their nests much as do the teals, but are, perhaps, more inclined to seek out standing tufts of dried rushes, doubtless because in them they can more readily conceal their bulkier bodies; at the base of these they have no difficulty in forming a safe and commodious retreat. At first, and in the majority of cases, little attention is paid to the nest proper, and a slight collection of dried rushes and grass, sufficiently hollowed to contain the eggs and the body of the bird, is all that is required. The lining of soft down, plucked from the breast and belly of the devoted female, is deferred till later, it rarely being found till the complement is nearly completed, and it more frequently still being left until the eggs have been incubated for a considerable period.

I have never found more than ten eggs in a nest, though I have seen broods of eleven under convoy of the parents, and perhaps the full dozen are sometimes laid.

When disturbed the mallard rises heavily from its nest, its fright occasionally compelling a volley of loud quacks, while at other times it flies away in perfect silence. In case of the female, she may then show her concern by flying in wide circles near the nest; and this she is especially likely to do when the maternal instinct has become strong by long brooding. But should the nest contain only a few newly-laid eggs, much less apprehension is displayed, and then she flies straight away to remain in hiding for some hours, or until completely reassured. Often, under the latter circumstances, the nest is never reoccupied, but a second begun after a delay of twenty-four hours or so.

Soon after being hatched, the downy young are led by their parents, not into open water, where would follow a well-understood danger from hawks and other enemies, but into the shallow inlets, where they can be screened by the heavy covert of reeds; and they are not allowed to venture out of these until able to shift for themselves. I think that for the first few nights after being hatched the tender young are led back and brooded in the nest. But the interval during which the young are most exposed to danger is in the "flapper" state, or when they have attained considerable size, but have not yet received thepower of flight, for the rectrices, as is well known, are the last feathers to be developed. They now flap along the surface of the water in a curious sort of way, half flying, half swimming, and when cornered in shallow water, as may often be done, they fall easy prey. This is the accepted time of feasting for numerous species of hawks, not to mention such formidable four-footed enemies as coyotes, foxes, etc., while most to be feared of all is its human foe in the shape of the Indian. Armed with clubs, the boys and squaws enter the shallows, and by beating the reeds drive the young before them till they are congregated in some favorable spot, when they are slaughtered by the scores. I have seen Indians returning from one of these ducking expeditions fairly loaded down with spoil, the young ducks hanging by the necks in festoons, and almost hiding by their numbers the dusky bodies of their slaughterers. Ducks' eggs and ducklings form in fact during summer no small part of the Indians' fare.

Probably none of the mallards raised in this region pass the winter here, but migrate south, and are replaced by more northern-born birds, so that about the numerous warm springs and ponds of open water the mallards are to be found throughout cold weather, until spring once more impels them northward.

DAFILA Leach.

D. acuta (L.). Pin Tail.

Abundant during the migrations; one breed.

CHAULELASMUS Gray.

C. streperus (L.). Gadwall.

This fine duck breeds abundantly throughout this region.

MARECA Stephens.

M. americana (Gm.). American Widgeon.

Breeds more or less commonly in this region; most abundant as a migrant.

QUERQUEDULA Stephens.

Q. carolinensis (Gm.). Green-wing Teal.

Scattered pairs of this teal breed over all this region, and in some localities it is doubtless numerous.

While crossing the desert north of Reno, early in July, we found in the solitary pool of water, which with its scanty growth of green rushes forms the only oasis for miles around, a family of this teal consisting of a female and ten young. The pool being of too small extent to furnish shelter in such danger, the mother bird led the band to the shore and directly into the sage-brush, into which they dived and hid as though fully alive to the emergency of the case.

This teal is most abundant as a spring and fall migrant, its proclivities hence being for more northern summer grounds.

Q. discors (L.). Blue-winged Teal.

This species was not seen at all during the summer; nor, as a migrant, does it appear to be as numerous in this region as either of its congeners.

Q. cyanoptera (V.). Cinnamon Teal.

This teal is one of the few ducks whose range is so far circumscribed that it may be spoken of in general terms as a western species, the area occupied by it, even during the migratory seasons, not extending to the east of the Rocky Mountains, except in

Texas. Although noted from Louisiana, its occurrence there is presumed to be quite accidental. It furthermore appears as a summer resident in almost every section where it is known at all. It breeds about the Columbia River, at present its northernmost recorded limit. Southern Colorado, on the other hand, as determined by our parties, is included in its summer range, as possibly also Arizona and New Mexico, although of the latter fact no absolute proof was obtained. In many localities in the intermediate regions it is one of the most abundant of summer visitants, and in no place more so, according to my knowledge, than in Western Nevada and the contiguous regions.

It makes its appearance on the lakes of Nevada early in the spring, at a date nearly coinciding with the general impetus northward to be observed in the ducks and water birds generally. At the time of my first visit to Washoe Lake, May 12, all of the teal appeared to be paired, while not a few had so far progressed in their housekeeping matters as to already have eggs.

With all the ducks there is noticeable a great variation in the time of nesting, even at the very same locality. The cinnamon teal forms no exception to this rule, and from the above date onwards I found nests in all the various stages of advancement. Fresh eggs were found as late as the 1st of June, although most of the nests at this date contained either young or eggs very far advanced. Perhaps a certain proportion of the late breeders are to be accounted for on the supposition of the destruction of the first nests, for ducks have many enemies at this season; and fresh duck-eggs as well as young birds have an especial attraction for all the smaller carnivores.

The teals' nests will be found scattered over a marsh at large, their chief care being to secure a dry spot out of reach of the danger of inundation, which is their principal risk, and the cause at times of the destruction of great numbers of the eggs. Some seasons of high water about Washoe Lake, as I was told by the ranchmen, prove most ruinous to the first clutches, and the swollen inlets of the marsh have been observed at such times to be fairly dotted with eggs of the various kinds of ducks, which had been floated off by the rising waters.

An apparently secure locality found, a pair soon satisfy themselves with some special little nook. They never, I think, build in the heavy beds of tule, but either select an isolated bunch of rushes, or else place the nest in the midst of the short waving marsh-grass, where it is sufficiently thick to protect the setting bird from ordinary observation. Occasionally, too, they nest upon the dry land under a bush, and more or less distant from water. But in any event the nest must be within easy reach of a good feeding ground, and is usually not many yards, perhaps but few feet, distant from some pool or stream. Ducks have plenty of opportunty for the exercise of cunning in their domestic arrangements, and some of the pairs display infinite address in hiding their nests, and the eyes of the most observant collector, be he two or four footed, will often in vain scrutinize the very clump of grass wherein is hid the mother bird nestling close down to her treasures, secure, till a blundering step starts her from her charge. If a clump of rushes be selected as a nesting site, the bird enters from the side through a space so small that, once inside, it needs but a few slight touches of the bill to replace the stalks disturbed by her entrance, and restore everything to its natural appearance. And this the female is knowing enough to do, as she is also to carefully cover the eggs during her temporary absences. Like the mallard, and probably most if not all other ducks, the cinnamon teal is very indifferent as to the state of the nest at the time the first eggs are laid, and leaves the final touches till towards the period when the young are about to appear. Then, to provide a soft bed for her offspring, the female quite denudes the under portions of her body of its downy feathering, and with the material obtained in this way warmly felts the nest.

The teal is a close setter, and the female will occasionally prove so devoted to her charge as to permit herself to be caught by hand. If the young be out, there is scarcely any limit to the hardihood she will show in her attempts to distract attention from them. She flutters along the ground just beyond reach of the outstretched hand, and resorts to every effort of dissimulation likely to induce pursuit. I have seen the wounded, broken-winged bird, in particular, imitated so cleverly by this teal, that it was difficult indeed to persuade myself that it was a cheat.

The extreme number of eggs at a hatching is, I believe, twelve; and in some thirty nests examined at Washoe Lake this number was found only twice; nine, ten, and eleven being the more common complements.

In fair seasons the greater number appear to be hatched out, as I never saw a small brood; and occasionally every egg proves fertile. That this should be the case seems a little remarkable, when is considered the irregularity which marks the intervals of deposition.

When newly laid the eggs are of a beautiful, soft, creamy white, and the texture of the shell is delicate and a trifle rough under touch. Very soon after the full complement appears the shell becomes smooth and shining from the constant contact and rubbing of the bird's body, and the delicate texture is lost entirely. The color is also correspondingly changed, and now appears as a light buff, which darkens and stains as time goes on. Such are the usual museum specimens. Their exact shape is somewhat indeterminate, since, in the sets before me, many approach the true ellipsoidal, while others are simply oval in varying degree; some are elongated and quite pointed at the smaller ends; others are blunt. It is to be remarked that the peculiarities of size and shape are apt to obtain with but slight variations throughout the whole of a set. The two smallest eggs before me measure 1.88 × 1.27, and 1.82 × 1.32; and from this extreme they run up to 2.10 × 1.37.

The cinnamon teal is, in the interior, one of the very first of the ducks to start in fall on the southward migration, and, in the neighborhood of Washoe Lake, nearly all have left by the first of September; while those that breed farther north are not long in following. In California it remains later, and I understand from my friend, Mr. H. G. Parker, that more or less winter in the Sacramento Valley.

SPATULA Boie.

S. clypeata (L.). Shoveller.

This duck is abundant in fall and spring in nearly all portions of the West. Nevertheless if it remains to breed, it does so apparently only in rare instances, except along our northern border, as in Dakota, where the young were found by Dr. Coues in August.

It is true that I detected the species at Washoe Lake in June. But upon killing a male the cause of its stay so far south was revealed in the shape of an old wound; probably, too, a greater or less number of barren birds are scattered over the lakes of this region.

FULIGULA Stephens.

F. marila (L.). Greater Blackhead.

Numerous only as a migrant and winter visitant.

F. affinis Eyton. Lesser Blackhead.

Occurs as the preceding.

F. collaris (Donov.). Ring-neck Duck.

In noticing this species on previous occasions, especially in the report for 1876 I have given it as breeding in Utah, Nevada, &c. I was led into what I now am convinced was a mistake by the incorrect identification of several young birds. These I now ascertain to have been the young of the redhead (*F. americana*), as similar specimens taken the past season of unquestionable identity show. I take this occasion therefore to make the correction, and all such references are to be understood as applying to the redhead, and to it alone. We have no proof at the present, so far as I am aware, that the ring-neck breeds within our limits, and it doubtless retires in summer to points far beyond our boundaries. During both spring and fall it occurs in greater or less numbers according to locality.

F. ferina americana (Eyton). Redhead.

Better known, perhaps, as a bird of the east coast, the redhead is yet a well-represented species on the west coast, and also to a somewhat less extent of the western interior. It was found breeding, though not in great numbers, about Washoe and other lakes in Western Nevada and the contiguous portions of California. This is, I believe, a summer range much farther south than is usually understood to apply to this species; although young birds taken at Rush Lake, Southern Utah, by myself, affords good evidence of its summer residence at that point.

Its method of nidification is in general much like the other species. One nest found by Mr. H. G. Parker was somewhat singularly placed, in that it was built in perfectly bare, open ground. A hoof-track in the mud, which had subsequently been left high and dry by the receding waters, received the nest, composed in this instance entirely of feathers and down, there being, in fact, no room in the narrow quarters for other accumulations. A second was built close to the water's edge under protection of a little clump of grease-wood bushes. The eggs numbered in these instances respectively five and seven, incubation in neither having begun.

I append the measurements of three of the first set, merely remarking that, except for their more spherical form and perhaps rather larger size, they would be indistinguishable from the mallard's: 2.23 × 1.73, 2.21 × 1.73, 2.17 × 1.70.

BUCEPHALA Baird.

B. clangula (L.). Common Golden Eye.

An abundant migrant.

B. albeola (L.). Buffle-head Duck.

As preceding species.

PELECANIDÆ—Pelicans.

PELECANUS Linnæus.

ythorynchus Lath. White Pelican.

e white pelican is less known from its occurrence on either coast than from the dant numbers that inhabit the great interior lakes. From their great extent, and in instances complete isolation, as well as their containing an abundance of fish, the of Nevada, California, and Oregon are especially favored by this bird, and on cer- f them, as Pyramid, Eagle, and Goose Lakes, the pelicans are found in summer in nse numbers.

much has been written from time to time upon the breeding habits of this species, most persons interested in the subject may be presumed to be pretty familiar with , and this part of the bird's biography need not be enlarged upon here to any t.

turally the white pelican seems to be rather stupid, and, when the privacy of a ling colony is encroached upon for the first time by a human being, the liveliest g his presence is apt to excite is intense curiosity, which is occasionally carried to an extent that the birds appear as though too completely overwhelmed with as- bment to take any special precaution for their own safety. Under such circum- es they may occasionally be so closely approached as to be-killed with clubs. No ure however so dull as not to profit by the lessons that experience teaches, and reatment the pelican usually receives at the hands of man is of such kind that in hey soon learn to recognize an enemy to be feared and shunned on all occasions. is the case at Great Salt Lake where the former great abundance of the pelican ested by all the early explorers, but where now the bird is known only as a cas- isitant. Persecution is having a similar result at Pyramid Lake, Nevada, where years ago the birds were so tame as to permit themselves to be almost caught and. At present, though still abundant, they are excessively shy having been n entirely away from certain of the islands by treatment which must eventually their complete disappearance.

m its large size and conspicuous plumage, and the habit of colonization at esting period, added to the complete exposure of the eggs upon the sands, and y from the fact that the young when hatched are perfectly helpless for a period er a month, the pelican is peculiarly exposed to the assault of its enemies. From footed foes it secures immunity by nesting upon islands, a precaution which, of e, proves of no avail from its human persecutors.

Pyramid Lake a crusade has been inaugurated against the pelicans by the fish- n, whose cause is justified in their own eyes by the voracity of the big birds, and umber of fish consumed by them. In a single day, as I was informed, over 700 belonging to one colony were destroyed. This complaint of injury done the fish- nterests is not, it must be said, without some foundation. The number of pounds h consumed in a day by the combined numbers of a large colony of pelicans, ially when feeding young, must amount to something fabulous. As a rule, how- and from the nature of the mode of fishing practiced by the white pelican, fish lue, as the trout, are but little exposed to their attacks; the species they are to obtain consists chiefly of the smaller fry found in shallow water, and of little table-value whatever, their principal, if not their only, importance being as food etter kinds. As this small fry fairly swarms in all the western lakes, there is no er at present, at least, that the fishing interests will be injured in this indirect er, as indeed is plainly evidenced at Pyramid Lake, where, despite the number of elicans, trout exist in enormous numbers.

e method of obtaining their prey by banding together, driving the fish before into shallow water and then scooping them up with open bill by means of quick s, I have often witnessed and is well known. The large size of the fish a pelican, r emergency, is able to dispose of, is somewhat surprising. I once saw a bird h had been wounded, and which was apparently unable to clear the surface of ater, throw up a sucker which I estimated to weigh not less than three pounds. ng rid itself of extra ballast to this extent, it flew away with ease.

e deposition of the pelicans' eggs takes place at a very early date; the colony at mid Lake, as I learned, having laid many eggs by April 10, and this is I think about sual date. As might be presumed, all the pairs of a colony do not begin laying e same time; in fact there is much irregularity in this respect, and as a conse- ce there results a corresponding difference in the time of appearance of the young. was clearly shown in the case of a community of from 500 to 1,000 pairs that established themselves on a sandy island in Eagle Lake (Cal.), and which I d July 4. At this date the young were present in all stages of growth, from the just breaking the shell to the youngster fully grown, but still unable to fly. A rough estimate placed this number at considerably over 1,000, and a more incongruous assemblage was never witnessed. As our boat approached the island the parent birds began to manifest some uneasiness, and when we were about two gunshots away they rose *en masse* and settled in the water at convenient distance for watching our proceedings. The younglings were considerably flustered when they found such strange creatures among them, and treated all our advances with marked disapproval. Forming into solid phalanxes of all sizes, they shuffled over the sands, the ranks opening to right and left with all alacrity according as we directed our steps. The appearance they cut as they waddled about on their unsteady legs, some of them almost naked and all ugly and uncouth, was ludicrous in the extreme. Even the older ones made no attempt at aggressive resistance when captured, but were content to show their repugnance at being handled by violent efforts to escape from our hands. Finally, in response to the coaxing of a few old birds that ventured in, many took to the water, and, having swam out three or four hundred yards, remained quietly eyeing our movements with all unconcern. Many gulls and several pairs of cormorants and great blue herons shared the island with the pelicans, and their young afforded living proofs of the unruffled tempers and good dispositions of the big birds.

At this lake the pelicans presented a peculiarly noteworthy sight as at intervals during the day they spread their broad wings and flew in bands of from five to fifty to the neighborhood of some one of the lofty peaks within a mile or two, where they amused themselves by sailing about for an hour at a time in the invigorating air and in encompassing the summits in wide circles. Their snowy-white plumage reflected the bright sunlight, and the huge birds appeared at their best as they soared above cañon and forest at such height that all ungainliness of form was lost and we were left to admire the snowy purity of their colors and their fine powers of flight.

The "centre-board," so called, a horny excrescence appearing on the bills of the adults about the mating period is, as has been shown by Captain Bendire, common to both sexes. This is shed as the season progresses, till, in early July, when the young are usually well advanced, it is rarely seen, although a few still persist at this time. Of its use nothing appears to be known.

GRACULIDÆ—Cormorants.

GRACULUS Linnæus.

G. dilophus (Sw.). Double-crested Cormorant.

The cormorants from this region have usually been referred to the variety *floridanus*, a name bestowed upon what was supposed to be a small southern race of *dilophus*. But my pair of specimens taken at Pyramid Lake, Nevada, in summer, are fully up to the requirements of size of *dilophus*, and I therefore so consider them. It is to be remarked, however, as has been indicated by Mr. Ridgway, that specimens occur in the region under notice, and in California, that are no larger than many Florida born birds. After examination of the Smithsonian material I am of the opinion that the alleged difference of size is of too doubtful applicability to warrant the recognition of this variety.

The double-crested cormorant is more or less numerous on many of the lakes of this region, its abundance at any given locality being chiefly regulated by the presence and character of nesting facilities.

All the nests examined by me were built in depressions and cavities on rocky islands, although in this same region they build upon trees, as fully attested by Mr. Ridgway. The nests were composed chiefly of sticks with a substantial lining of weeds. One was noticed that had an additional slight felting of feathers. No birds could well be less fastidious in regard to their nesting arrangements than they, and the foul odor about a cormorant rookery is almost unendurable. Entangled in one nest that I examined was the mummied head and neck of a brother cormorant that apparently had been gathered as available nest material.

Although the flight of the cormorant appears heavy and somewhat laborious, it yet progresses from feeding ground to feeding ground with tolerable ease and much swiftness. But the bird appears at its best in the water, where it is scarcely less at home than the typical divers, and where no little of its existence is passed beneath the surface in pursuit of its finny prey. This the cormorant never plunges for, but, like the grebes, divers, and other birds of that class, the best swimmers of all, captures it in full chase. The bird's forays are usually made into large schools, and apparently it has very little trouble in procuring all it requires. The cormorant is not always successful in holding a fish after it has fairly seized it, and at Eagle Lake there were to be seen in every school of white-fish (*Coregonus williamsoni*) a considerable number that bore across their bodies the marks of the powerful mandibles. I found quite a number of sizable fish that had escaped from the birds' bills, only to die a lingering death from the effects of compression.

LARIDÆ—Gulls, Terns.

LARUS Linnæus.

L. californicus Lawr. California Gull.

The present species is to be distinguished from the *L. delawarensis*, which it somewhat closely resembles, by the following characters:

L. californicus, adult—size larger; bill stouter; (wing, 15.43; tail, 6.24; bill, 1.82; depth above notch, .60; tarsus, 2.23).*

Mantle dark pearl blue, much darker than in the succeeding. Color of bill (in fresh specimens, sometimes retained in skins) bright yellow, *with an irregularly shaped spot of intense carmine near tip of lower mandible;* a spot or bar of black anterior to this on both mandibles. Iris hazel or brown; tarsi and feet pale green.

L. delawarensis, adult—size smaller; bill less robust; (wing, 14.49; tail, 6.06; bill, 1.45; depth above nostril, .51; tarsus, 2.07).†

Mantle pearl blue, always lighter than in preceding. Bill greenish yellow, encircled near tip by a broad black band. Iris light yellow; tarsi and feet naples yellow.

The amount of black on the bill of *californicus* is variable. Usually it takes the form of spots or bars, as given above, but such is by no means always the case. Not rarely, as in several adult specimens before me, it appears in the form of a complete circle as in *delawarensis*. In such cases, however, the ring is much narrower than in that bird. More rarely the black is almost or quite obsolete. Similarly, or even more variable, is the amount of white at tip of first primary. In a majority, perhaps, of specimens this is found as a terminal patch of about two inches in extent. Some individuals, however, apparently perfectly adult, have the tip and shaft black for three-fourths of an inch, the white being restricted to a spot on either web above the black area, almost precisely as in *delawarensis*. Others, again, may have the extreme tip white, above which is a band of black including both webs and the shaft, and giving way, higher up, to a second white area which may or may not include the shaft; sometimes, indeed, the shaft is black above and white below. Hence the spotting of the primaries and the black markings of the bill, points upon which considerable stress has been laid by some authors, are too inconstant to prove reliable guides in diagnosis, although not entirely without value.

In fall the adults of either species have the white of head more or less spotted or streaked with dusky. The carmine spot on the bill of *californicus* fades away, as also the crimson of eyelids and at angle of mouth, which is common to both species. The differences in size, especially of bills, and the color of the mantles may now be relied upon to separate them. To distinguish young birds, which always exhibit so much individual variation, becomes much more difficult, and I have found the size of bill to be the best and most constant feature.

The Californian gull is found as a very abundant summer resident throughout the entire chain of lakes, and is, so far as I can learn, the only representative of the family present here at this season. Upon stretches of sand, jutting out from the little islands in mid-lake, or occasionally among the rocks along shore, this gull constructs its nest, and deposits from two to four eggs about the middle of May. The nest is a somewhat rude and bulky structure, particularly if it chances to be placed in rocky interstices, and is composed of weeds, sticks, and similar coarse material gathered from the shores, and lined more or less substantially with finer gleanings.

The colonies are, as a rule, very large, one that I visited on Pyramid Lake containing several hundred pairs, and the nests occupy every available spot on the sands. Unfortunately for the gulls, the eggs are rich and sufficiently well flavored to be a welcome addition to the meager fare of the settler, and hence, when accessible, are eagerly sought for. The colony alluded to above had been visited every few days for a period of more than three weeks, and every nest rifled. But so tenaciously do the birds cling to a spot that has once been chosen as a nesting ground that many still continued to deposit eggs, sometimes in newly-constructed nests, but often in the plundered ones. Many of the females had laid so often that the coloring pigment had been exhausted, and, as a consequence, a considerable portion of the later eggs were almost unspotted. The eggs of this gull are so nearly like those of the ring-bill as to be practically indistinguishable, although they average a trifle larger. In the exact style and amount of markings they vary interminably.

L. delawarensis (Ord.). Ring-bill Gull.

Given by Captain Bendire as a "common summer resident" of Malheur Lake, Oreg. It is possible that a mistake has been made here, and that the statement really applies only to the *L. californicus*. If correct it furnishes us with the only instance of the bird breeding within the United States. Upon all the other lakes in California and Nevada that I have visited the ring-bill appears to be only a fall and winter resident, and as such is numerous.

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* Average of four specimens.

† Average of eight specimens.

STERNA Linnæus.

S. forsteri (Nutt.). Forster's Tern.

Dr. Coues appears to have received an entirely erroneous impression in regard to the breeding range of this species, and assigns the interior of British America as its summer home, implying in his article in Birds of the Northwest its entire absence from the United States at this season, although he intimates a possibility of its being yet found to nest on or along the northern tier of States. The truth is this tern is an extremely abundant summer resident of Washoe and other similar lakes of Nevada and California east of the mountains upon which are found any considerable extent of tule or other marsh. It also occurs abundantly in summer in the great fresh-water marshes in the vicinity of Chicago, and also in Wisconsin. Upon the eastern coast its summer range is somewhat erratic, as it appears to be wanting along the New England coast, but is found at this season, in great numbers, on certain of the islands off the shore of Virginia and to the southward. Its absence farther north is, perhaps, to be accounted for from the lack of suitable localities, since the Forster's is as much of a marsh-loving species as the black tern, in contradistinction to the Wilson's, arctic, and others, which habitually frequent the open water, or, at least, avoid more the sedgy marshes.

Upon the western lakes the Forster's and black terns mingle fraternally together as they conduct their search for food over the broad expanse of oozy marsh or along the shallow, reedy shores. Moreover, the Forster's tern, instead of building on the open sands, has recourse to the marshes, thus still further following the habit of the black tern.

The single nest found by me consisted of a few bits of *débris*, and was placed on a muddy bank by the side of a ditch of running water.

HYDROCHELIDON Boie.

H. fissipes (L.). Black Tern.

This species, which is a well-known inhabitant of our lakes both east and west of the Mississippi, makes its appearance in Nevada early in May, and by the 10th of the month is very generally dispersed.

A bird of the sloughs and reedy marshes, wherever found, its habits differ in but few and unimportant particulars. The character and extent of its nest vary somewhat with the locality it inhabits. Thus Dr. Coues tells us that it builds no nest of its own, but finds the matted *débris* of weeds a sufficient protection for its eggs, while Mr. Nelson's experience near Chicago was in effect that it invariably builds a substantial nest of its own, whatever the foundation may be. In one particular the custom of the species, wherever found, seems to be very uniform, namely, for all the pairs in a given locality to adopt the same plan, which is naturally determined by surrounding circumstances. In Nevada the method of nidification appears to be various, the nests in some neighborhoods being placed among the waving grass in a tolerably dry situation; in others, on firm tussocks; in others still, on beds of matted tules. In any event the formation of a certain amount of material of the bird's own gathering into some sort of a nest seems in this region to be the rule. I may note here some curious nesting sites selected by a large colony of these terns, which had established themselves in a slough that contained enough open water to form the home of numerous grebes (*P. auritus californicus*). The nests of the grebes, from which the young had departed not long before, had been utilized by the terns, and hasty gatherings of bits of dried rushes and the like had been placed upon the half-decayed and wholly filthy masses to receive their eggs. The utter lack of fastidiousness of the terns was further exemplified in the fact that in nearly every case their own eggs lay in close proximity to the rotten and abandoned eggs of the first occupants. In fact, in one or two instances the terns must have found it difficult to incubate their own eggs without partially covering one or more of these. At this date (July 24) some of the eggs were in the advanced stages of incubation, while others had been hatched. The most vociferous of the family under every-day circumstances, such an occasion as the present is sure to call out all the bird's powers of noisy vituperation. The cries of the parents as they flew close down to the nests had the desired effect of causing the young to hastily abandon the nests and seek shelter in the grass. One old bird that was sitting on an egg from which the bill of the imprisoned chick was just escaping refused to leave her charge at this critical juncture, and actually permitted me to approach in plain sight and take her in my hand.

Fish forms an unimportant item in the bill of fare of this species, as, unlike others of the family, it feeds in great part upon insects, which it takes in various ways, mostly as they fly from the grasses.

The species is present in Nevada during the latter part of August in somewhat diminished numbers, but in September all leave for the south.

DESCRIPTION OF NESTLING.—Head above smoky brown, the same color prevailing below, but becoming darker across the jugulum and lighter on abdomen; sides of head and loral region white; back and sides of body pale cinnamon brown, interspersed with irregular patches of black; bill black; feet brownish.

COLYMBIDÆ—Divers.

COLYMBUS Linnæus.

C. torquatus (Brunn.). Great Northern Diver.

From information received from various sources I had been led to consider this diver as of rather uncommon occurrence in the waters of this region. During the past season, however, it was met with several times on Eagle Lake, Cal., where a number of pairs breed regularly, and the same is true, I think, of Goose Lake, where, at any rate, the species was observed by our party during the late summer.

PODICIPIDÆ—Grebes.

PODICEPS Latham.

P. occidentalis (Lawr.). Western Grebe.

None the less striking because familiar is the appearance of this large grebe as seen upon the extensive lakes of Nevada, and the country generally west of the Rocky Mountains. At what time in the spring it makes its appearance in these latitudes I do not know. On the occasion of my first visit to Washoe Lake about the middle of May the water was dotted with water birds, and conspicuous among them, as well by its elegance of form as by its graceful motions, was this grebe. Subsequently, when in turn I visited the several lakes lying to the northward, I found it an abundant inhabitant of them all. Indeed, with the exception of Lake Tahoe, I know of no large body of water in the far West that is exempt from its presence. The high elevation of Tahoe, over 6,000 feet, probably accounts for the absence of the bird, as in all the other mountain lakes of less elevation I have always found it present in abundance.

There is a pretty close correspondence in the character of the food, the manner of obtaining it, and in the habits of nidification of the various species of this family, and my observations have not shown that the western grebe possesses any very marked individuality in these respects, unless such as arises from its great size and superior prowess in manner of obtaining food. The largest of our species, the present bird excels all the others in natatorial powers, and in its ability to remain a long time submerged, in which particular it almost rivals the loon. It is probable, therefore, that this grebe is able to avail itself of its remarkable powers in the capture of fish, and it hence lives more upon them than do the other smaller and less powerful species. But fish do not, I think, form by any means its principal diet. The larvæ of all aquatic insects, various worms and leeches, as also some kinds of aquatic plants, make up its chief dependence.

The western grebe is a wonderfully quick diver, as I have had occasion to learn when after specimens, and I have found it almost impossible to kill the old and wary birds even at very short range, provided the bird was not taken unawares and could see the flash of the gun. However true the aim, and whatever the precaution as to the place aimed at, the leaden pellets when they reached the spot found only empty space, where a moment before was to be seen the long, snaky neck of the cunning diver.

It is about the 1st of June when the various species of grebes begin to think of their domestic duties, and if they be watched now they will be found to have gathered together into loose companies, which are to colonize together later on, and to spend much of their time in swimming back and forth in a rather excited manner just off one of the many clumps of tules that grow around the margins of most of the western lakes. The shallow depths about such form, it is true, favorite hunting grounds at all seasons, but around the comparatively few spots that possess the necessary qualifications for nesting purposes the concentration of the birds will be more marked as well as more persistent. The thicker tangled recesses among the tules are shunned, and only those spots among the season's fresh growth selected, where the tall reeds, while affording ample protection as well from the waves of the open lake as from chance observation, will yet admit of unimpeded progress in swimming to and from the nest. Such a place found numerous pairs center in and form a sort of independent colony, and the preparations for the nest are leisurely gone on with. A few of the surrounding tule-stems are perhaps broken off or bent down, and other reedy material gathered and laid in a pile, the structure being ready for occupation when a slightly hollowed and homogeneous mass of this is raised so as to fully clear the surface of the water.

None of the many nests I have examined, either of this or the other species, have been moored as described by some authors. They have usually been perfectly free, except in so far as the reeds constituting a hedge about them offer a complete check to the chance of their floating off. Occasionally, it is true, a few of the surrounding stems have been bent down and made to enter into the composition of the nest. But this is rather rare, and is apparently to be looked upon as an entirely accidental circumstance, so far as any intention of anchoring the structure is concerned.

A less promising place to deposit eggs than the structure described can scarcely be imagined. The material, which is mostly gathered from the water, is muddy and soggy, and how it is possible to hatch eggs on such surroundings is a mystery to all but the grebes. The problem appears to be easy enough of solution to them, and solve it they do in a most satisfactory manner. I have never been successful in my efforts to catch sight of a grebe on its nest, and partly on this account, partly from the peculiar character of the nest itself, have been led to surmise that much of the labor of incubation is shirked by the birds of this family and is delegated to the warmth of the sun's rays, aided, perhaps, by the heat which arises from the decomposing nest material. Like other species, as the eared grebe, the present bird covers up the eggs in its absence, although occasionally I have found them exposed to view. I have never found more than four eggs to a nest of this species, but presume that this number does not represent the full complement.

The young begin to appear about the first of July, but many pairs at this date will be found to still be incubating. The chicks appear to leave the nest almost as soon as hatched, and their history at this early stage is full of interest. One need only push his boat through the tules at this season to find himself rewarded by the sight of some domestic scenes that will well repay his trouble, and will perhaps give him a higher idea of these birds of "low instinct" than is usually accorded them. The reedy recesses are full now of quaint noises, not heard at other seasons. The faint quackings of the young ducklings convoyed by their watchful parents, the harsh notes of the coots calling to their numerous progeny, the piping of rails, and the querulous sputtering notes of the ever busy marsh wrens, are blended into a common melody, that now swells into full chorus, now dies away into confused murmurs under the fitful midsummer's breezes. But notes, too, other than the above are to be made out in the confused gabble, viz: the high piping call of the grebes, and, if he manages adroitly, the observer will find himself directly in the midst of a family group or groups containing all the birds just mentioned. His appearance will be the signal for a hasty scattering of the startled community, but, whatever of the scene he may fail to take in, let him not overlook our grebe just now. At the first sign of danger the pair of old birds have warned the young, that respond with feeble pipings, and at the call placing themselves on the broad flat backs of their parents, who have ranged up alongside for the purpose they are transported to a place of safety. No more beautiful and touching sight can be imagined than that presented by the downy little creatures as they huddle close up to the old one's neck, and give themselves trustfully up to its protection. Both parents share equally in the care of the young, part of the brood accompanying one, part the other. In this manner, they are carried about from feeding ground to feeding ground, or removed when danger threatens. Even at this very early age the chicks, under emergency, are wonderfully adept at diving and swimming, and to catch one uninjured is a matter of no little difficulty.

A brief description of the young in the downy stage, hitherto undescribed, is subjoined. First stage: Body above, dark sooty brown, lightest along sides. Head and hind neck light ashy plumbeous, in contrast to the under parts, which are pure white. Bill black, extreme tip light yellow.

When about half-grown, and while still in the down, the young differ considerably from the above in color. The head above is then of a blackish brown, and the down on hind neck shows the same color at base. It would appear that the growth of down is continuous for a considerable period, the ends being constantly worn away by attrition, and that its color just prior to the replacement by the true feathering corresponds with that of the latter.

P. auritus californicus (Heerm.). Eared Grebe.

This diminutive species appears to reach its maximum of abundance only as we approach the west coast. In Nevada, Oregon, and California, it is by far the most numerously represented of the family, and may be found at the right season on any and all the lakes and ponds of this region, where exist the proper nesting facilities. Though apparently absent in summer over much of the interior region proper, through all which, however, it migrates, it has been ascertained by Dr. Coues to breed abundantly along our northern frontier, as in Dakota, while on the other hand a sizable colony was found breeding in Southern Colorado, by myself. This may prove to be an extreme point in its summer range, but I think not, and that there is at least a probability of its occurrence still farther south, in Arizona.

Much of the account of the breeding habits of the previous species will apply equally well to the present bird. The nests are the same characteristic structures, the only difference being one of size, and the eggs are deposited about the same time. The habit, mentioned elsewhere, of covering the eggs with a perfect screen of weeds seems to be everywhere a constant one with the eared grebe, and I have never found a nest in which the eggs could be seen without first uncovering them.

Both parents share in the care of the young after birth, and, as in the case of the larger species, the young are carried about on their backs. The families are difficult to find at this season, as they rarely visit the open water, but keep sedulously within shelter of the tules, whence their shrill calls may be heard coming from all directions, and yet not a bird, young or old, be seen, unless extreme care be taken in approaching them.

The following is a description of the young:

First stage.—Head above black; a faint yellowish white line begins at base of bill, divides on forehead, and passes over either eye to hind neck; the latter is also streaked with white. Body above blackish brown; each down shaft tipped with ash; sides washed with plumbeous. Under parts rosy white.

As will be noticed, the young of this species differs sufficiently from the similar stage in any of the others as to be readily identifiable.

PODILYMBUS Less.

P. podiceps (L.). Pied-bill Grebe.

Although not nearly so abundant as the eared grebe, the "dabchick" is yet abundantly represented on the waters of this region in summer, and doubtless also to a greater or less extent as a resident species. The Pied-bill nests in the same localities as the eared grebe, and in the general particulars of habits the two agree closely.

The young of the present bird have very decided markings about the head, broad white and dark lines being contrasted alternately. On the back of the head are several irregular patches of bright rufous.

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NOTE.

The following topographical atlas sheets, seven in number, issued during the fiscal year ending June 30, 1879, accompany the additional copies of the Annual Report for 1879 of Capt. George M. Wheeler, Corps of Engineers, in charge of United States Geographical Surveys, and are in continuation of the series embracing the territory of the United States lying west of the 100th meridian. (See Progress Map.) Upon all the above sheets the classification of their areas into Agricultural, Timber, Grazing, and Arid or Barren lands is shown by colors:

1. Atlas sheet 32 D. Part of Southeastern Idaho, including portions of the Snake and Bear River drainage, the latter tributary to the Great Salt Lake Basin; showing, also, the ancient outlet of Lake Bonneville at Red Rock Pass, Fort Hall in the northwestern corner of the area, and a portion of the Utah Northern Railroad passing through the Port Neuf Cañon. Area, 4,023 square miles, or 2,574,720 acres; scale, 1 inch to 4 miles, or 1:253,440.

Wanting 2 and 3. Atlas sheets 47 B, 47 D (double sheet). Parts of Eastern California and Western Nevada, including portions of the drainage basins of the Feather, Yuba, American, Truckee, and Carson Rivers; Tahoe, Pyramid, Winnemucca, and Honey Lakes, and the so-called Mud Lakes; also, the country in the vicinity of the Comstock Lode, and that portion of the Sierra Nevada through which the Central Pacific Railroad passes. Area, 8,406 square miles, or 5,380,480 acres; scale, 1 inch to 4 miles, or 1:253,440.

4. Atlas sheet 61 D (reissue of June 30, 1879). Part of Southern Colorado, and lying principally in the Rio Grande basins, including the greater portion of the San Luis Valley; shows, also, present terminus of the Denver and Rio Grande Railroad at Alamosa. Area, 4,326 square miles, or 2,768,640 acres; scale, 1 inch to 4 miles, or 1:253,440.

5. Atlas sheet 73 A. Part of Southern California, including on the east a part of the Mohave Desert, belonging to the Interior Basin system, and on the west a portion of the Great Valley system of California; showing Kern Lake and part of Kern River. These two basins are here separated by spurs and minor ranges, extending southward from the Sierra Nevada, crossed at the Tehachapai Pass by the Southern Pacific Railroad, which traverses the area from northwest to southeast. Area, 4,466 square miles, or 2,858,240 acres; scale, 1 inch to 4 miles, or 1:253,440.

6. Atlas sheet 78 A. Part of Central New Mexico, including portions of the drainage basin of the Pecos and Canadian or Red Rivers, and delineating the great mesa system connecting the mountains extending from the northward with the plains of New Mexico; shows the present terminus of the Atchison, Topeka and Santa Fé Railroad in the vicinity of Las Vegas. Area, 4,466 square miles, or 2,858,240 acres; scale, 1 inch to 4 miles, or 1:253,440.

7. Atlas sheet 84 B. Part of Central New Mexico, including a portion of the drainage basins of the Pecos in the eastern, and of the Rio Grande in the northwestern, part; also, the barren plains constituting the northern extension of the Jornada del Muerto, a peculiarly marked lava-flow east of the San Andreas and Oscuro Mountains; several minor mountain ranges to the eastward and Fort Stanton. Area, 4,554 square miles, or 2,914,560 acres; scale, 1 inch to 4 miles, or 1:253,440.

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